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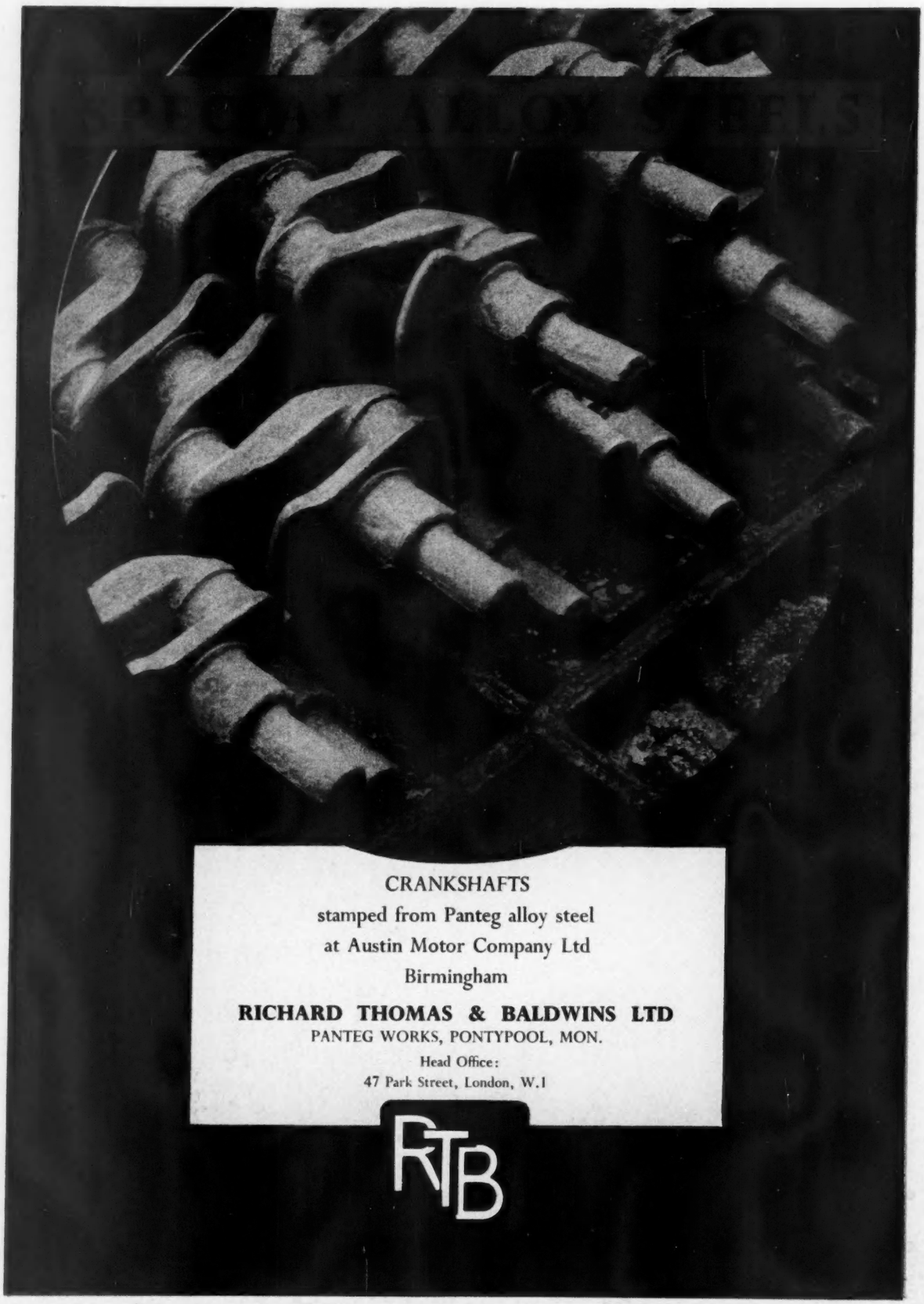

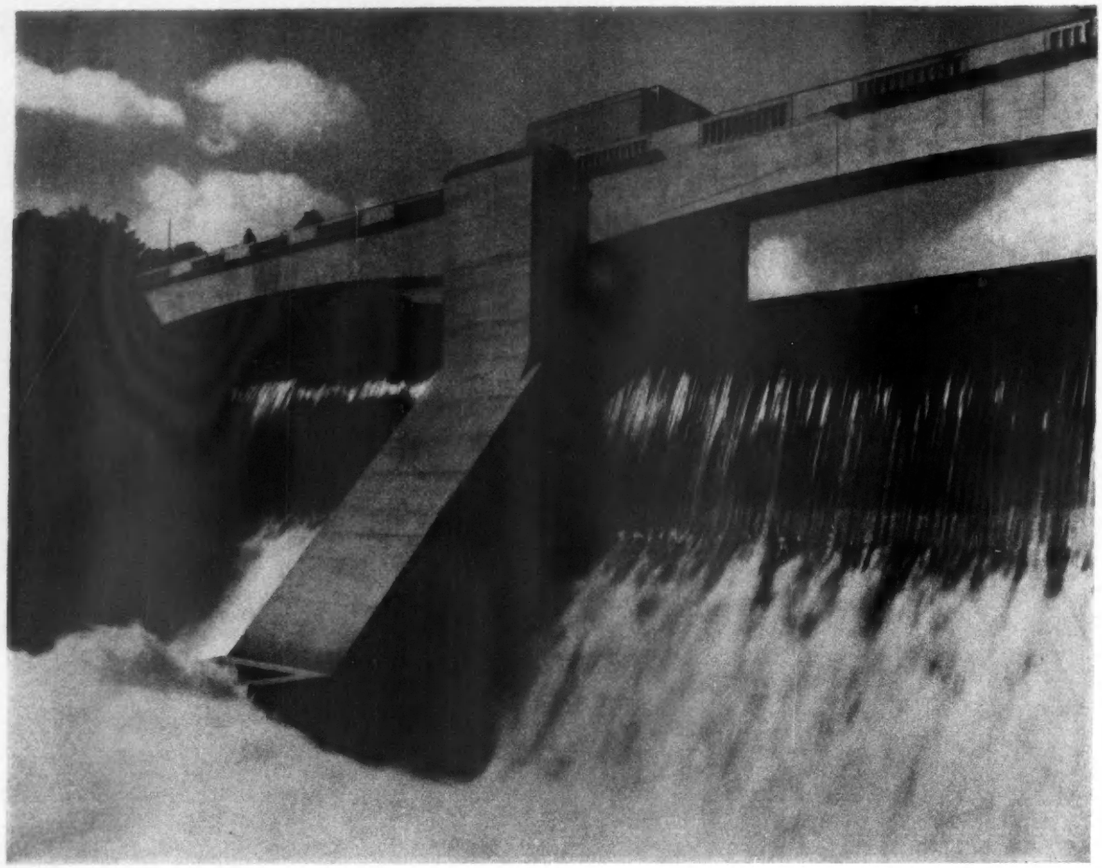

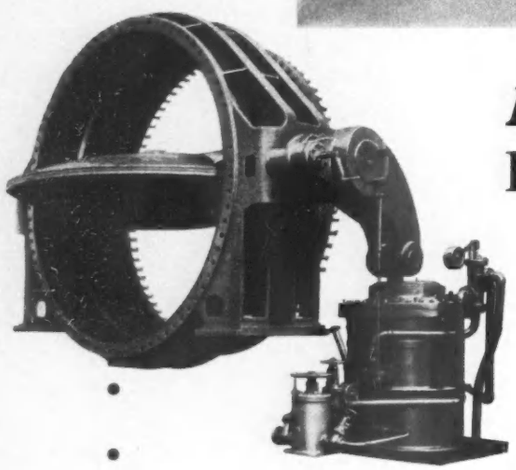

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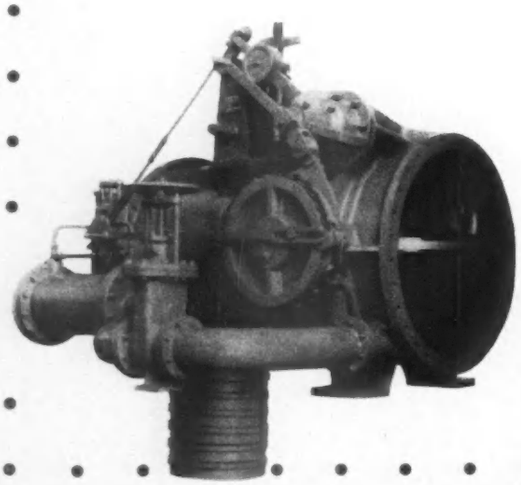

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EDITORIAL CONTENTS

Leading Articles

Works Training in Sandwich Courses 121
Wear and Tear 122
Labour Relations 122
The Reserve Fleet 123

Articles

100 Years Ago 123
North of Scotland Hydro-Electric Schemes. No. IX. (Part III). 124
National Institute of Agricultural Engineering 126
A. K. Bruce Rudolph Ackermann, 1764–1834 128
T. F. W. Smith Graphical Method for Oblique Bending 129
Progress of Indian Steel Plants 130
J. E. Johnson More Wear and Tear 131
Reinforced Concrete Structure for Bulk Storage 136
Institution of Naval Architects in France. No. II 137
Frit for Vitreous Enamelling 139
Technical Reports 140
Pametrada Annual Report 141
Malleable Iron Foundry 142
Two-Colour Offset Litho Press 143
Essex Firm's Centenary 144
Building Research, 1957 144
Report of Euratom Commission 144
Motor-Cycle Innovation 144
Mechanised Coal Depot 145
Straddle Carrier Development 146
Plywood-Faced Shuttering Panels 146
Press Cushion Pressure Control Attachment 147
Thread Milling Machine 147
Grinding Machines 147

Continental Section

Swiss Transformer Factory 149
Twelfth Achema Congress and Exhibition. No. III 151
Construction and Dock Cranes. Swedish Extrusion Press 154

American Section

Tape Control System for Machine Tools 155
Hot-Extruded Cold-Drawn Steel Sections 156
Geneva Conference on Peaceful Uses of Atomic Energy 156
Large Contouring Lathe for Missile Components 157

LETTERS Comprehensive List of Engineering Relics. Thomas Graham Menzies. Railways into Roadways 134

BOOK REVIEWS 135

NEWS AND NOTES Industrial and Labour Notes 148
Personal and Business 158
British Patent Specifications 159
British Standards Institution 160
Launches and Trial Trips 160
Catalogues and Brochures 160

INDEX TO ADVERTISERS: PAGE 115 **CLASSIFIED ADVERTISEMENTS: PAGE 107**

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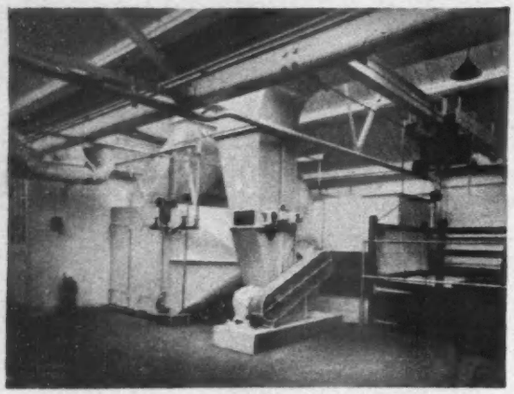

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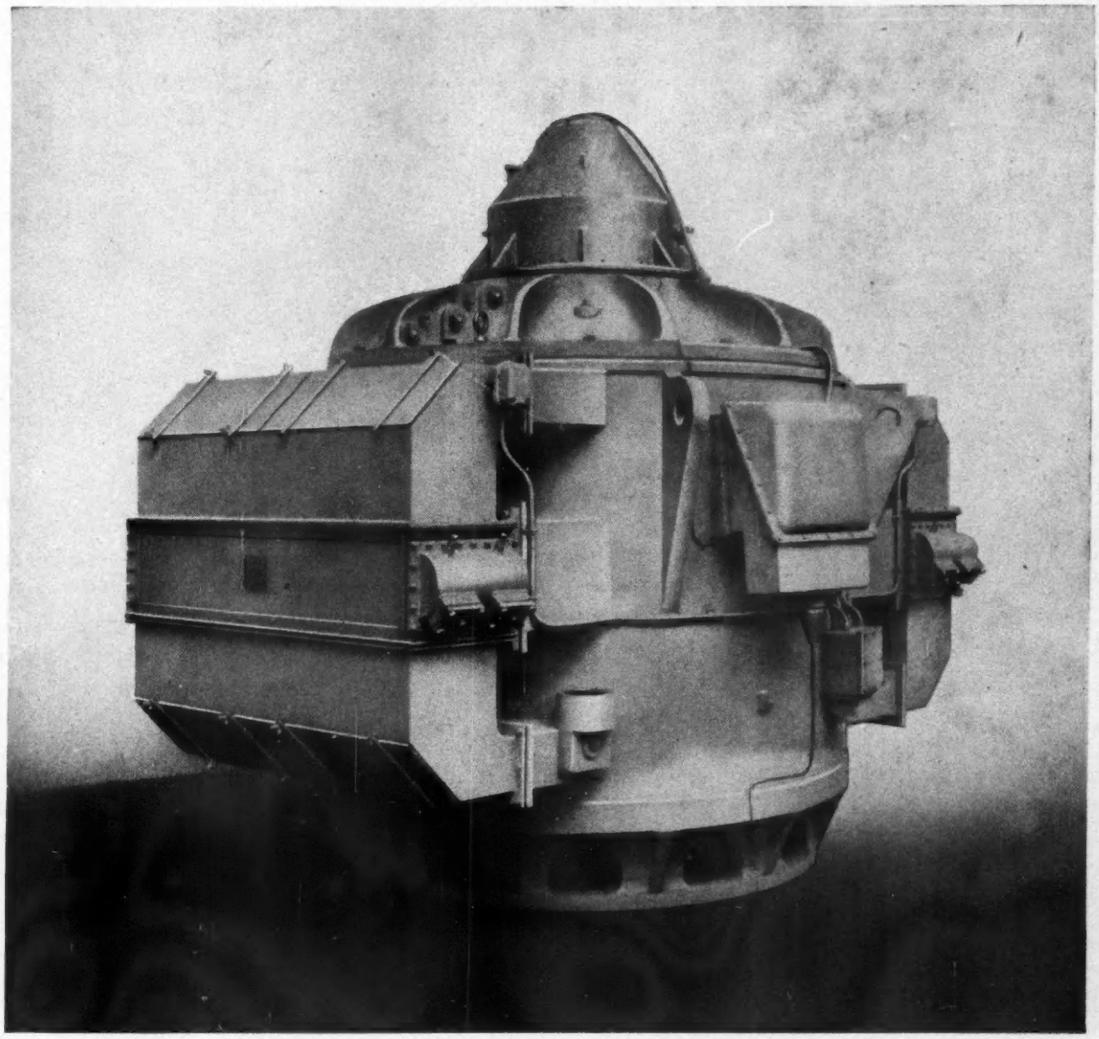

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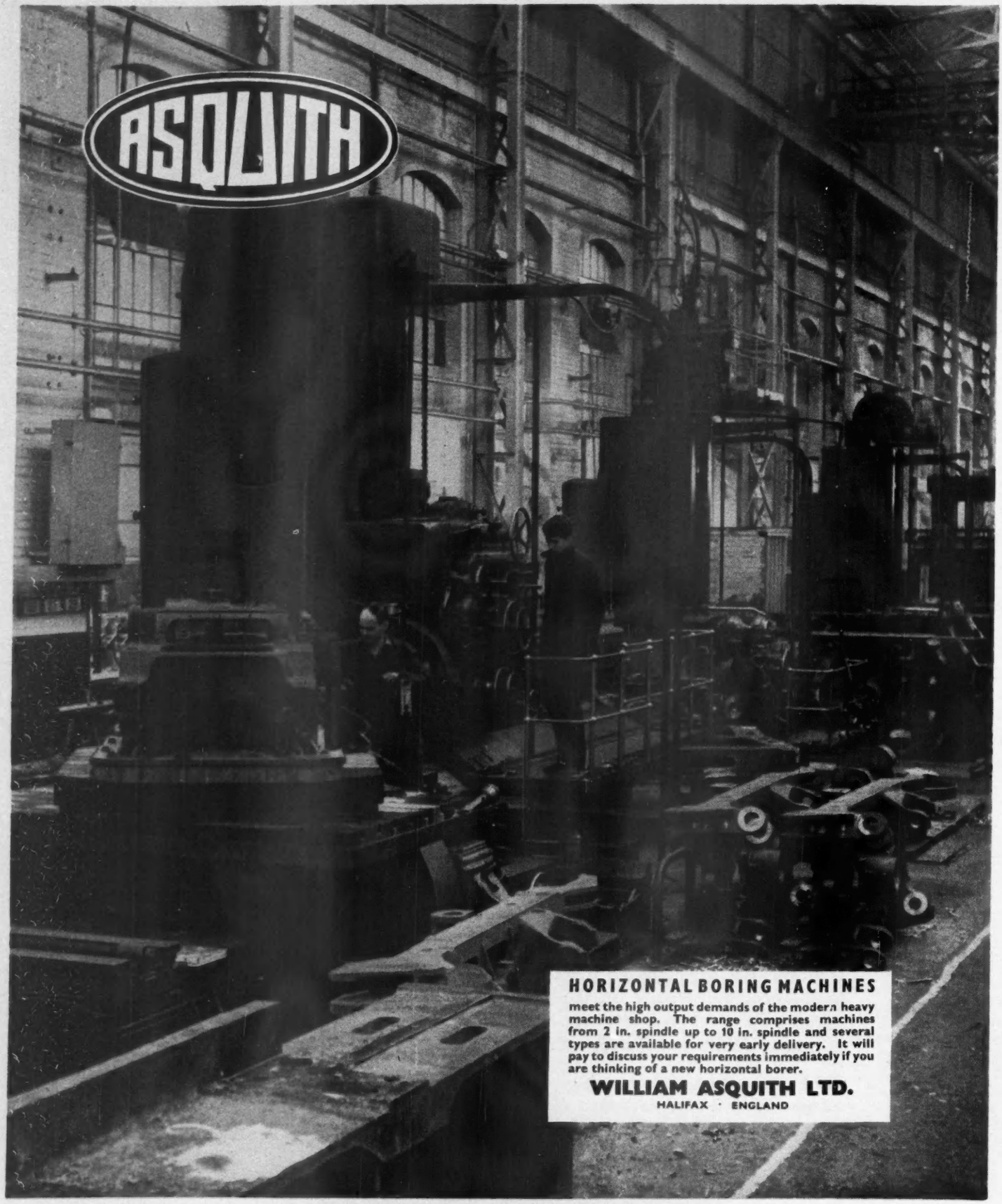
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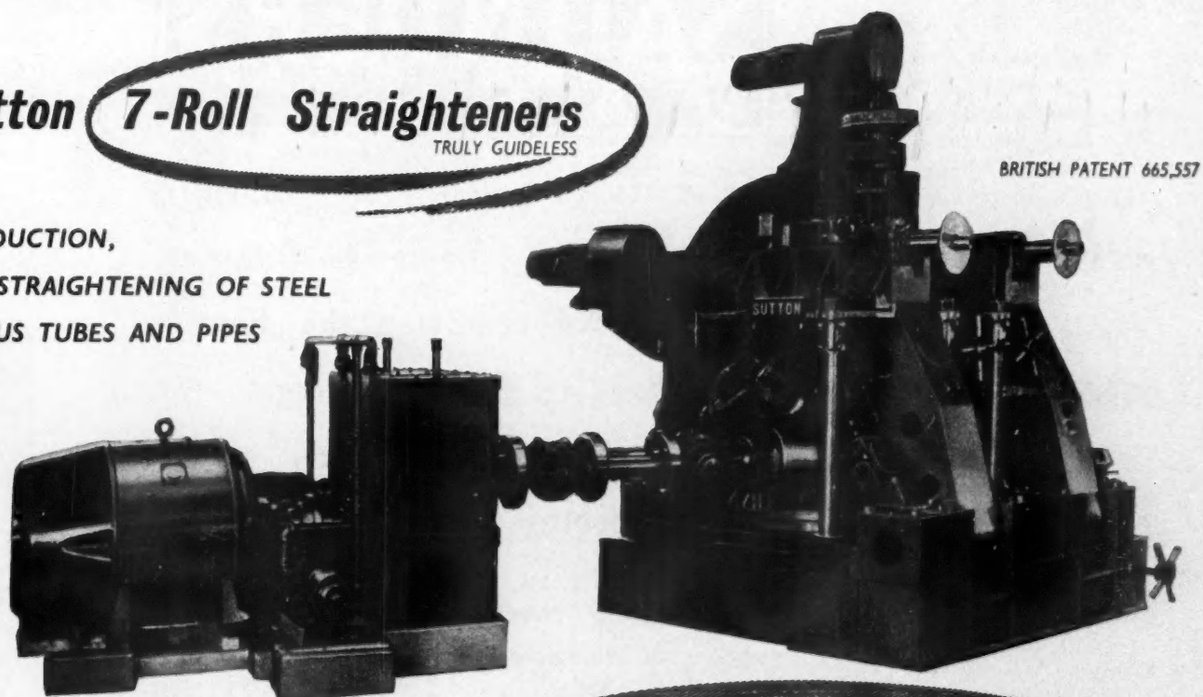

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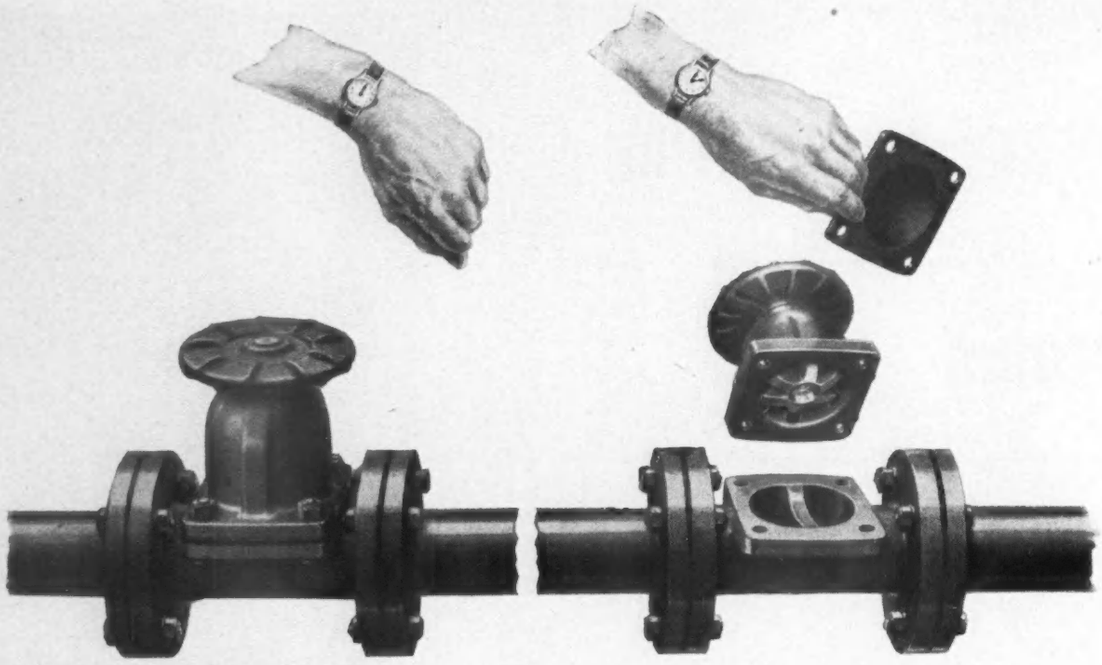

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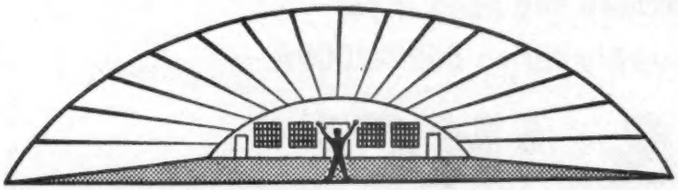

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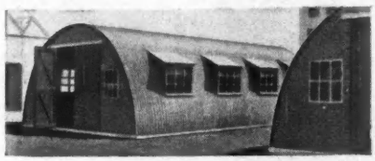

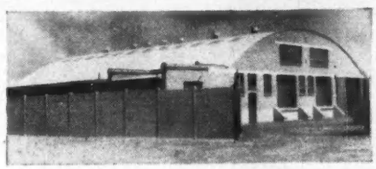

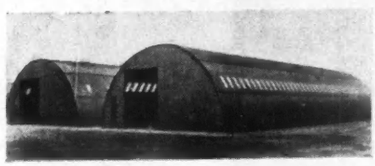

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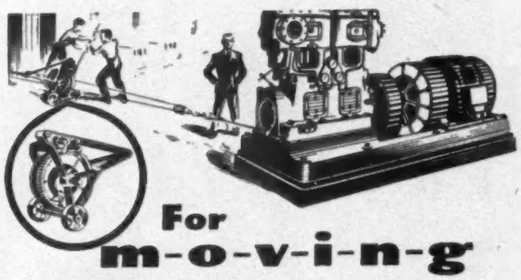

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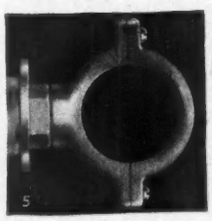

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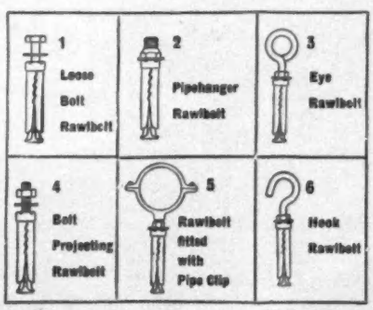

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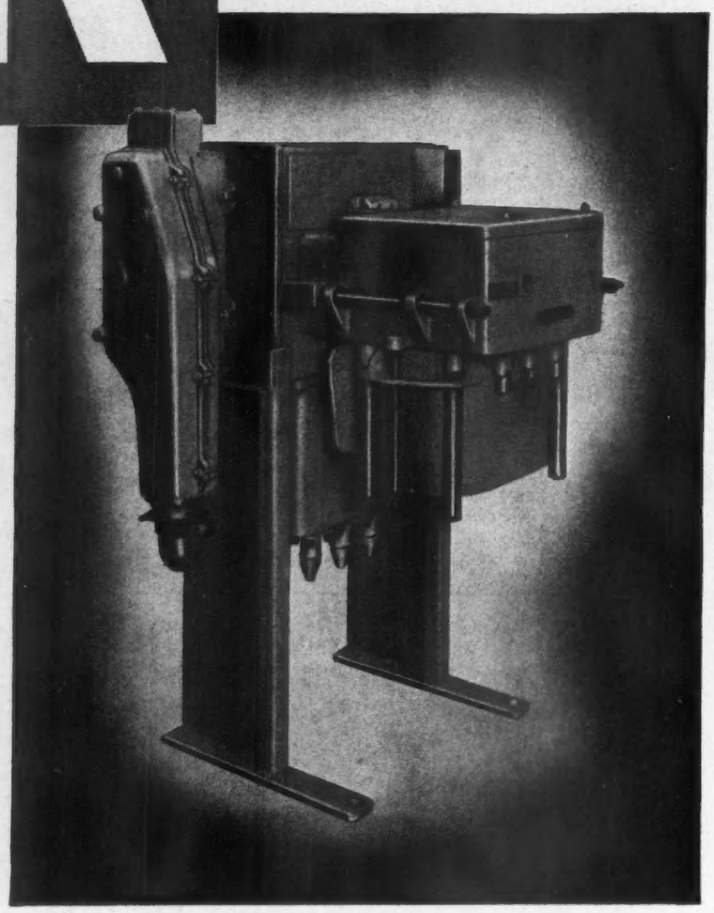

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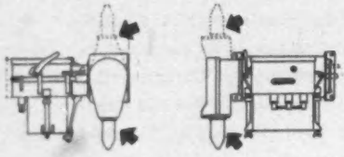

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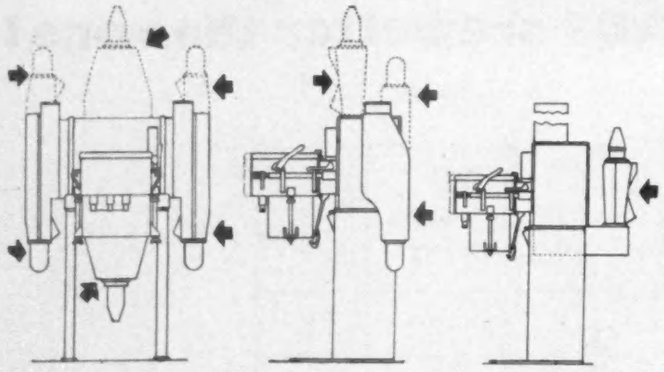

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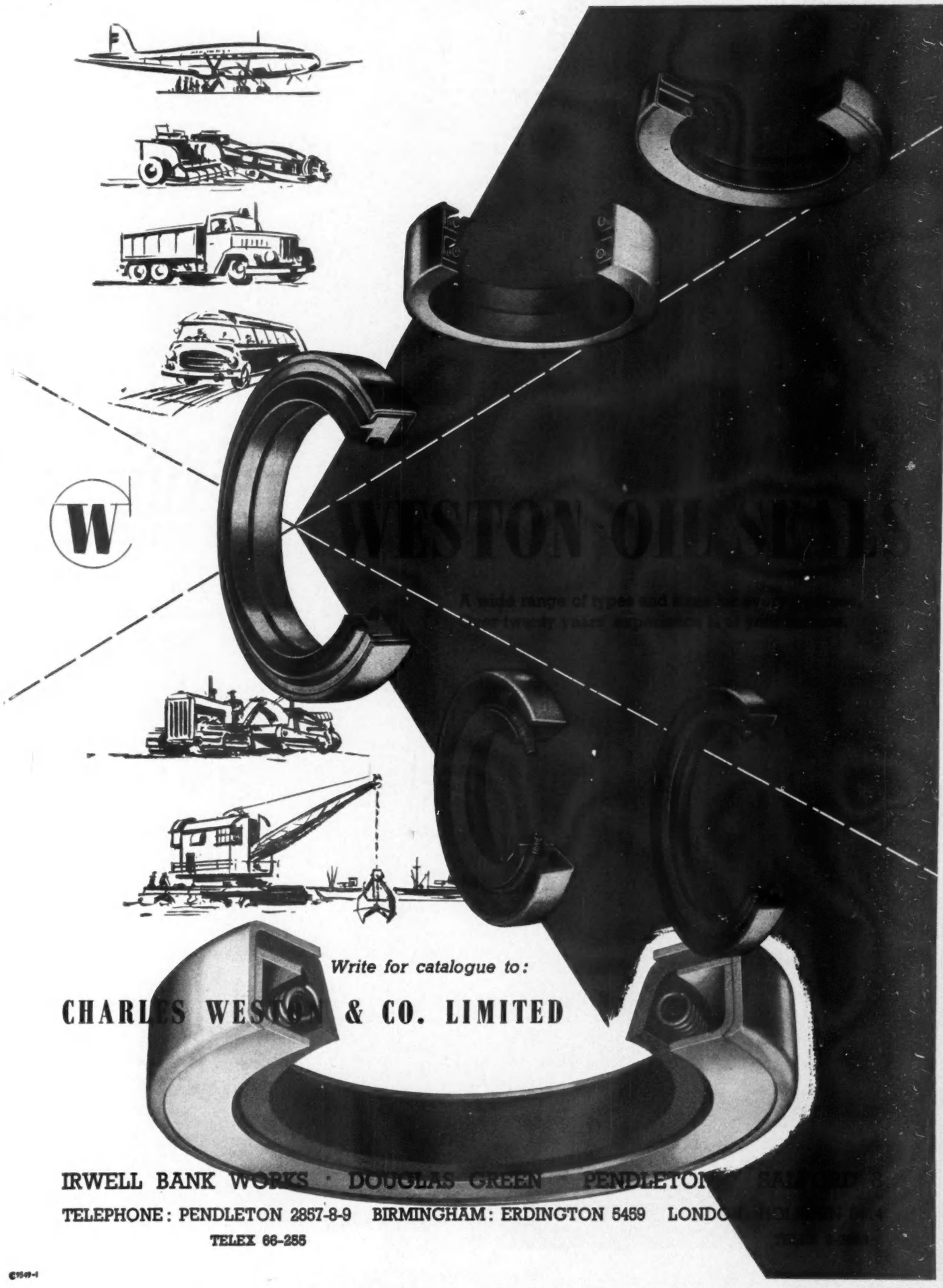
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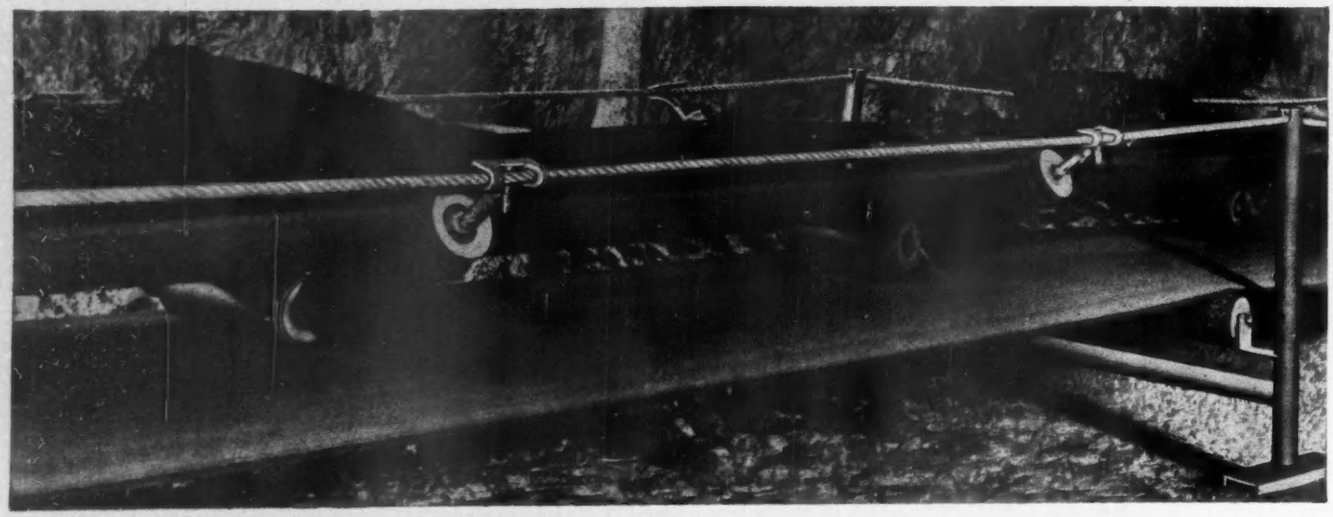

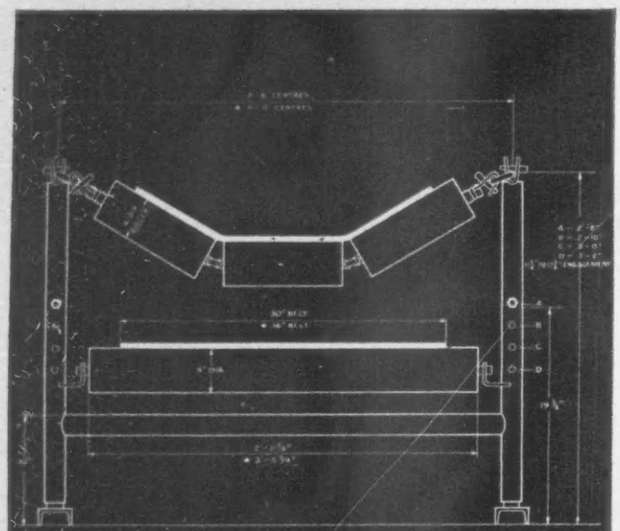

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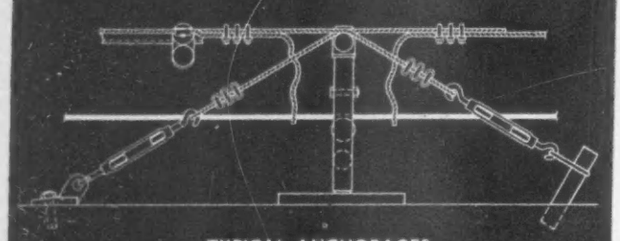

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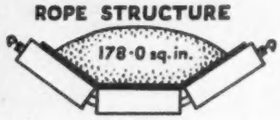

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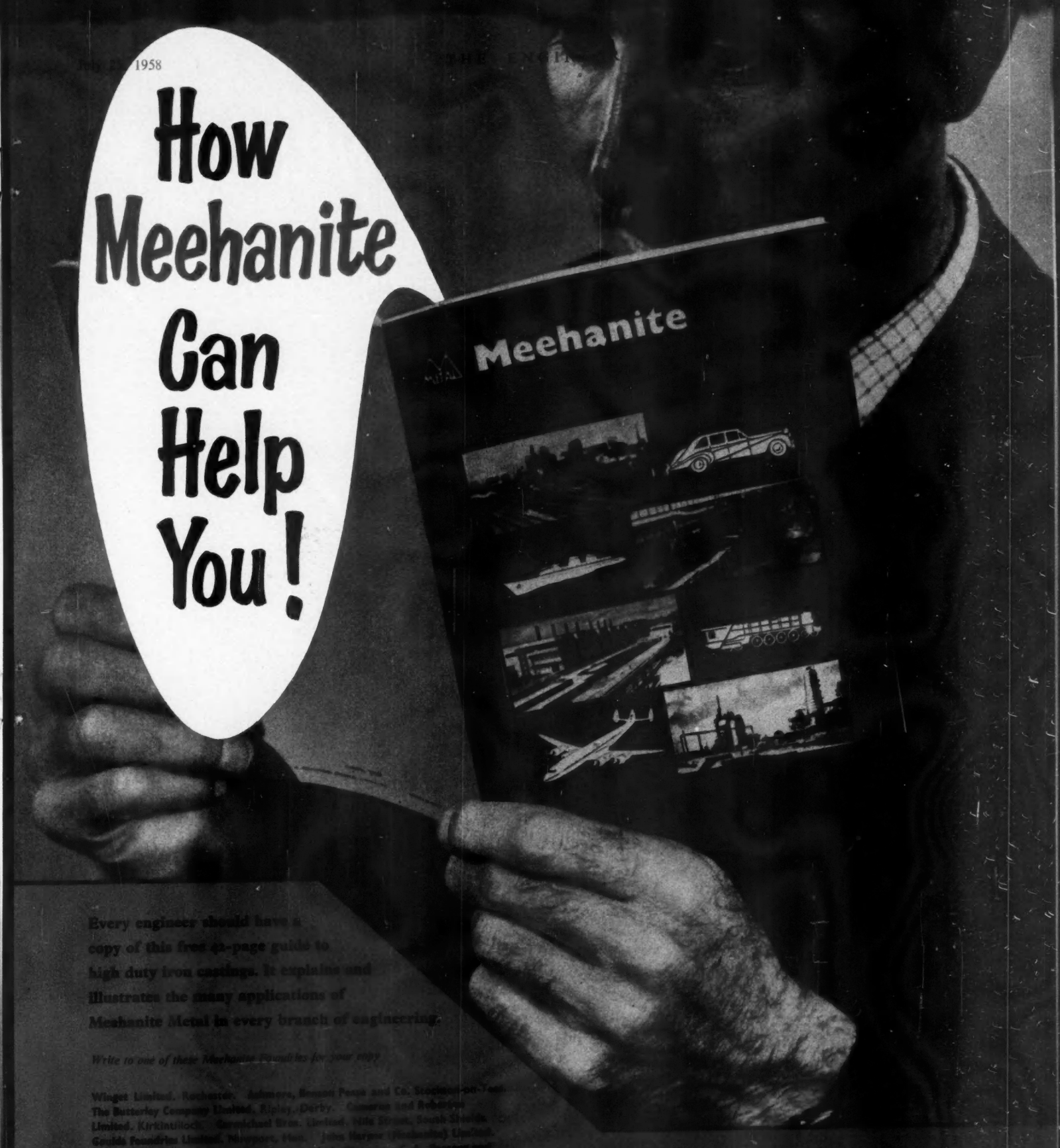

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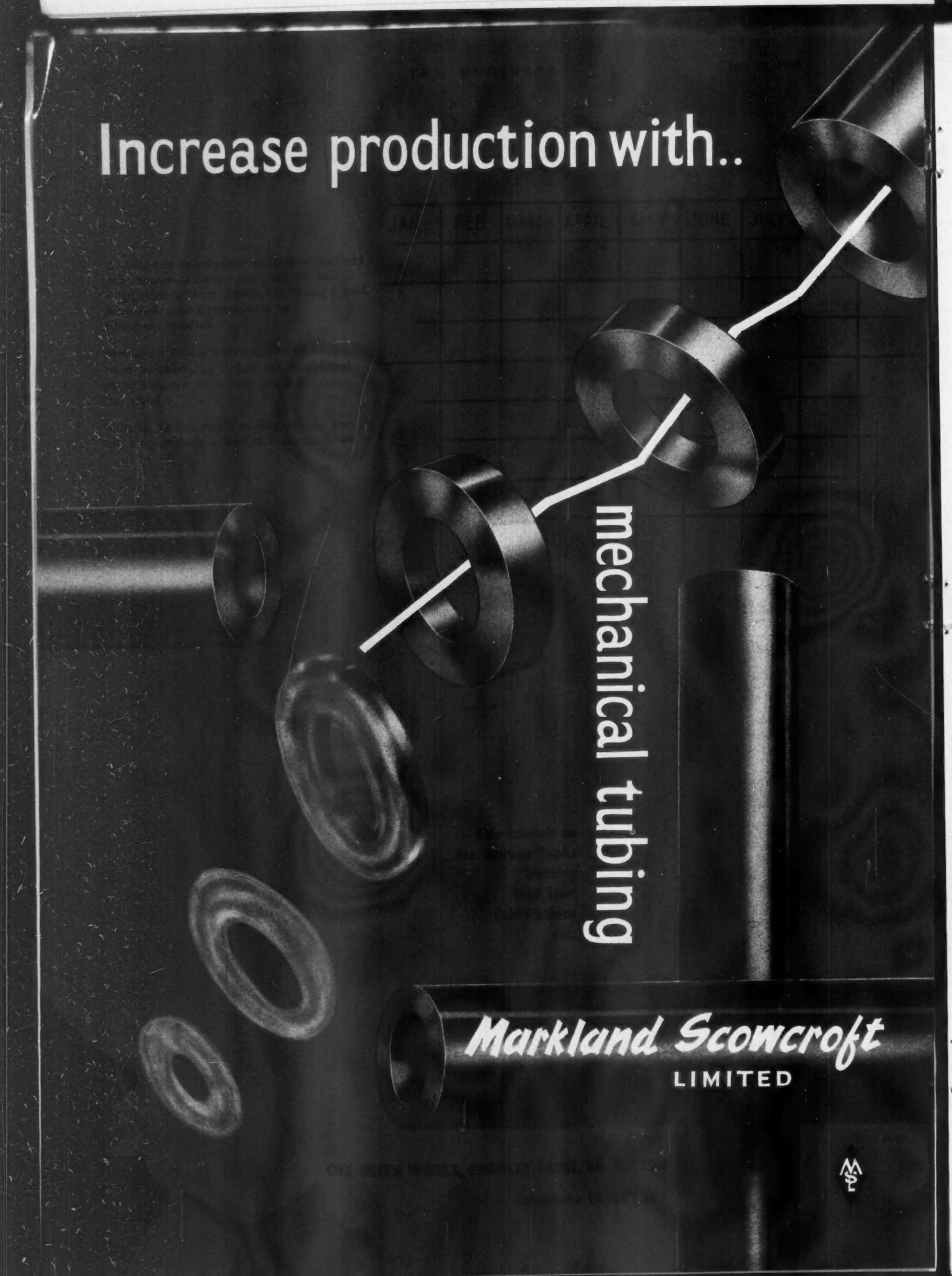

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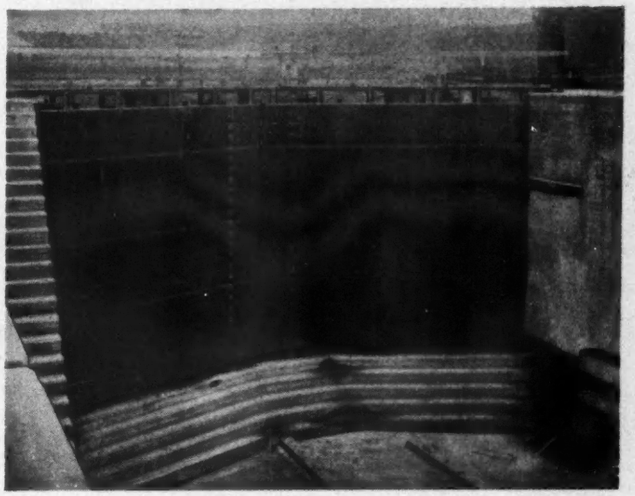
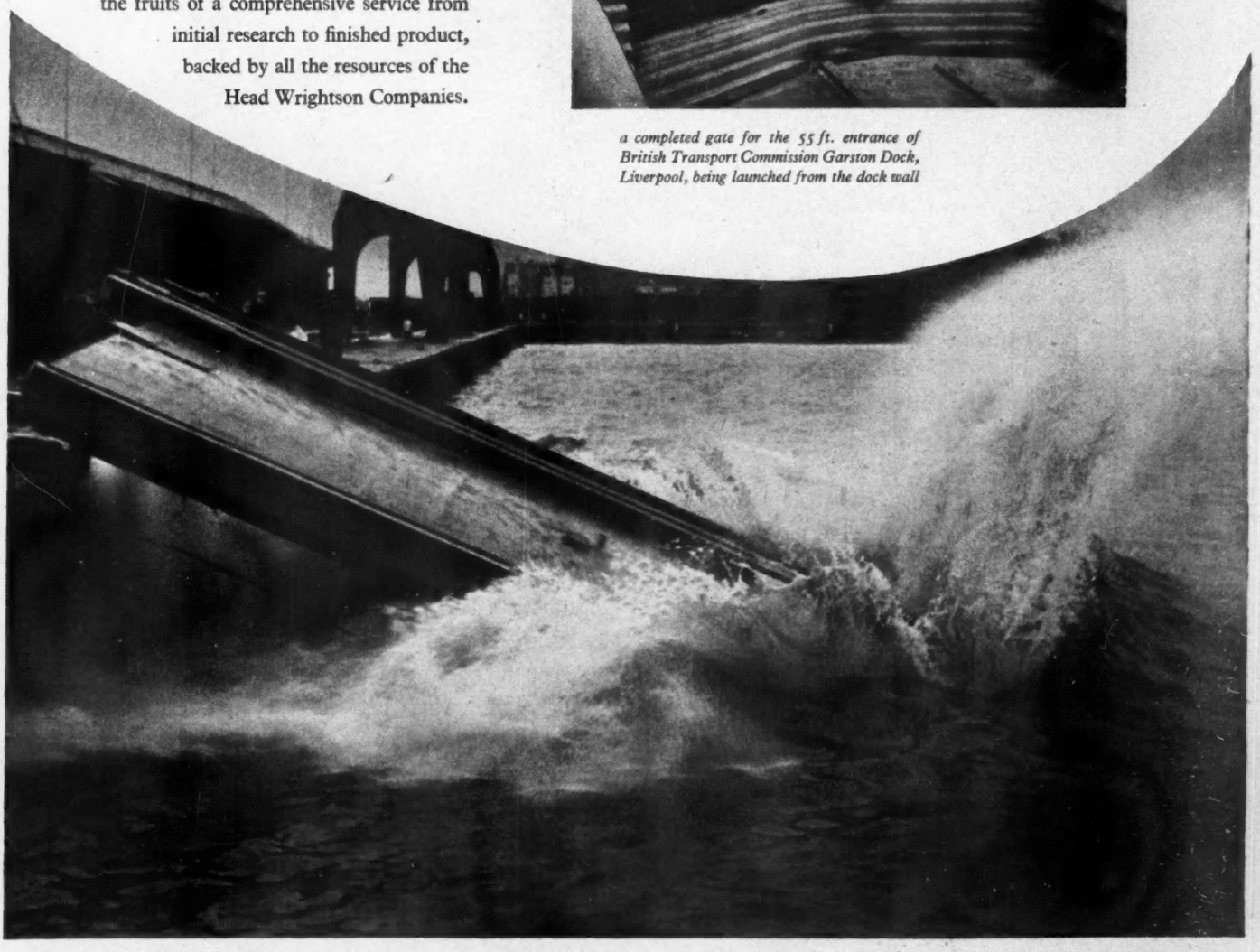
a pair of gates in pos tion





a completed gate for the 55 ft. entrance of British Transport Commission Garston Dock, Liverpool, being launched from the dock wall

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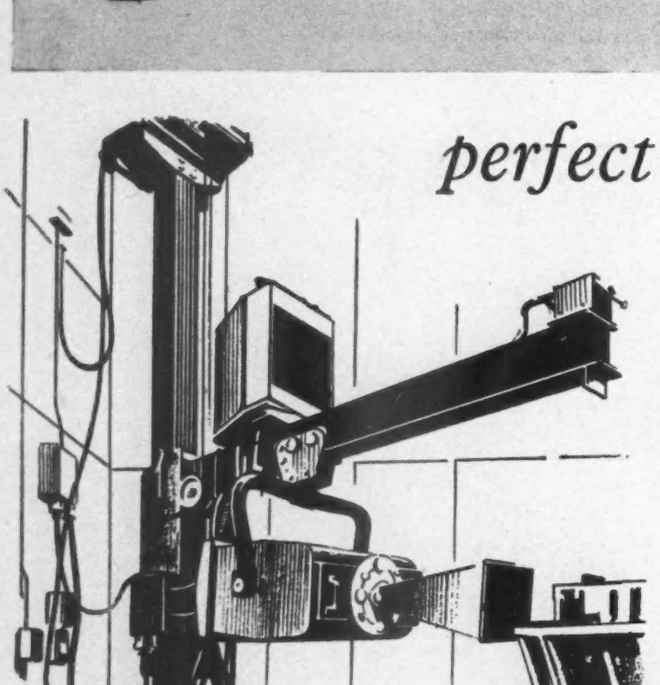

perfect welds are vital

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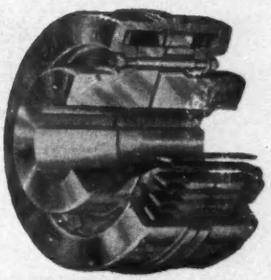

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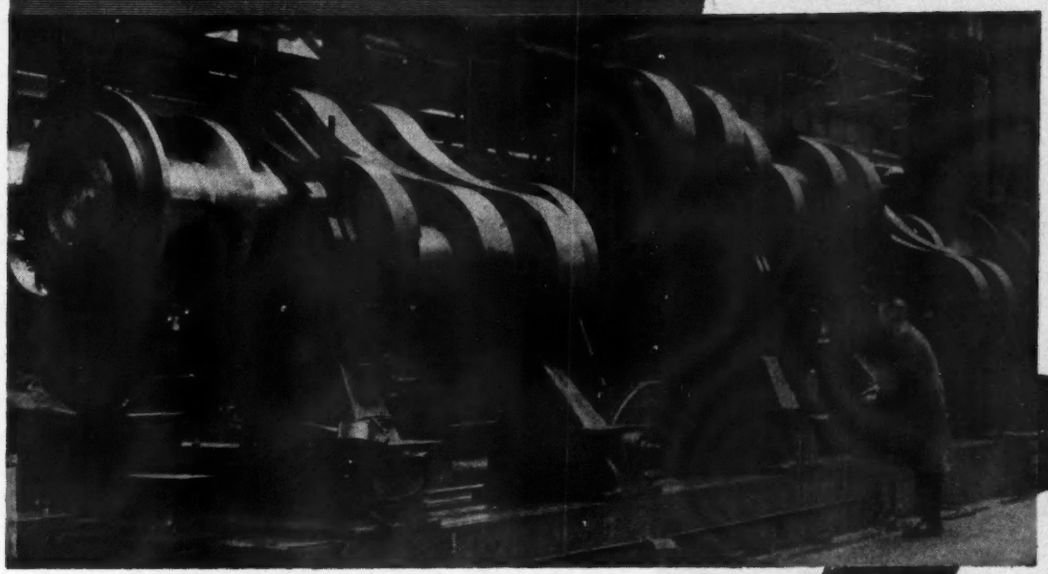

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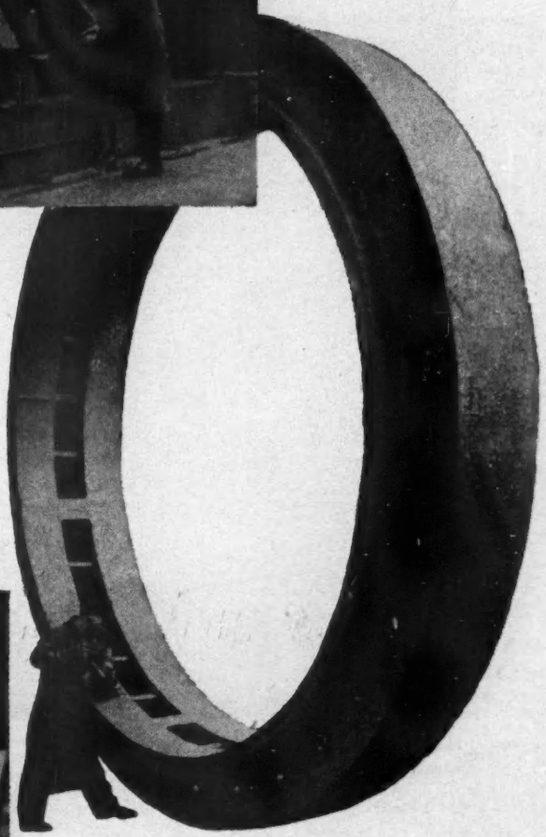

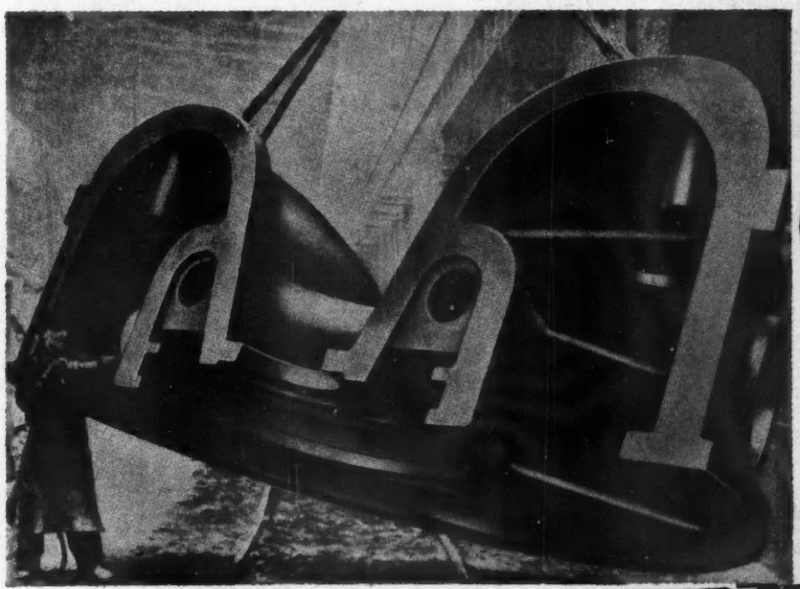

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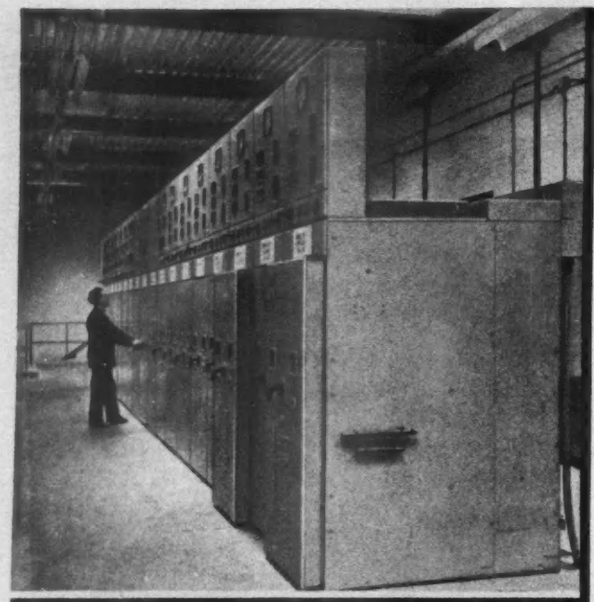

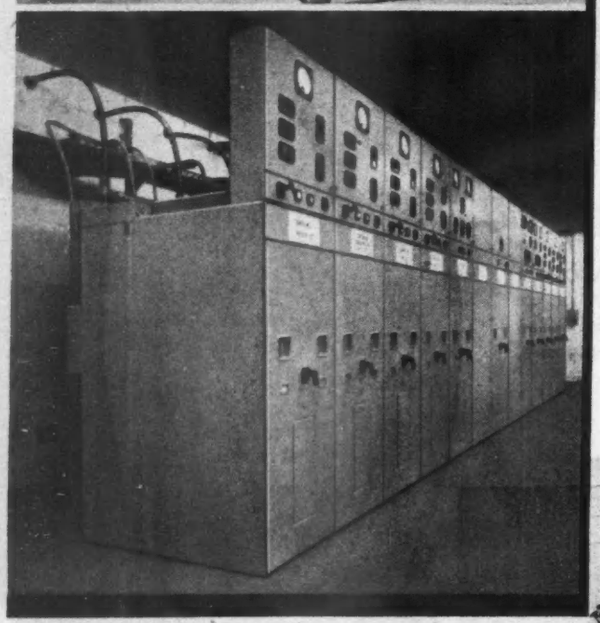

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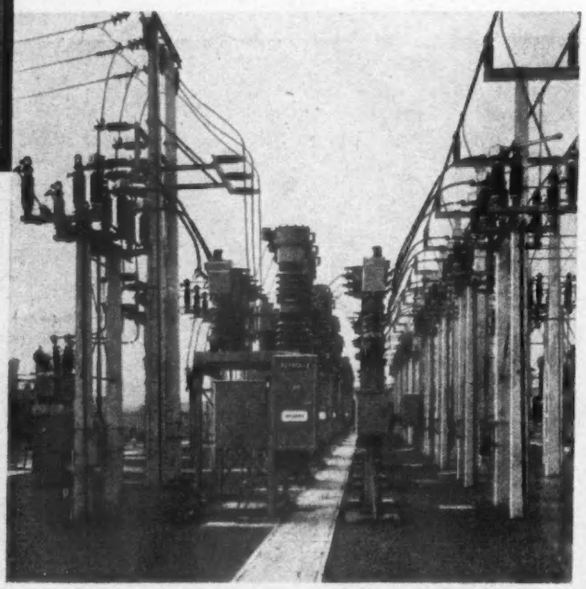
The electrical distribution within the Velindre Works is controlled by Reyrolle 3·3-kV 150-MVA air-break circuit-breakers.

Reyrolle also supplied the 33-kV 1000-MVA outdoor small-oil-volume circuit-breakers controlling the incoming supply.

Photographs by courtesy of The Steel Company of Wales and the South Wales Electricity Board



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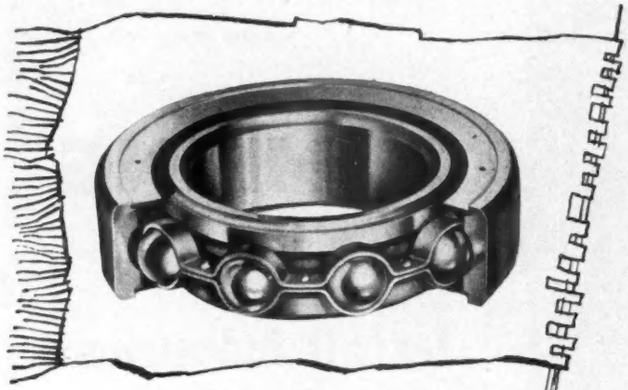

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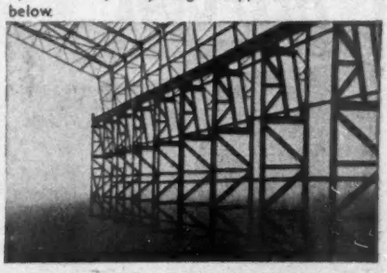

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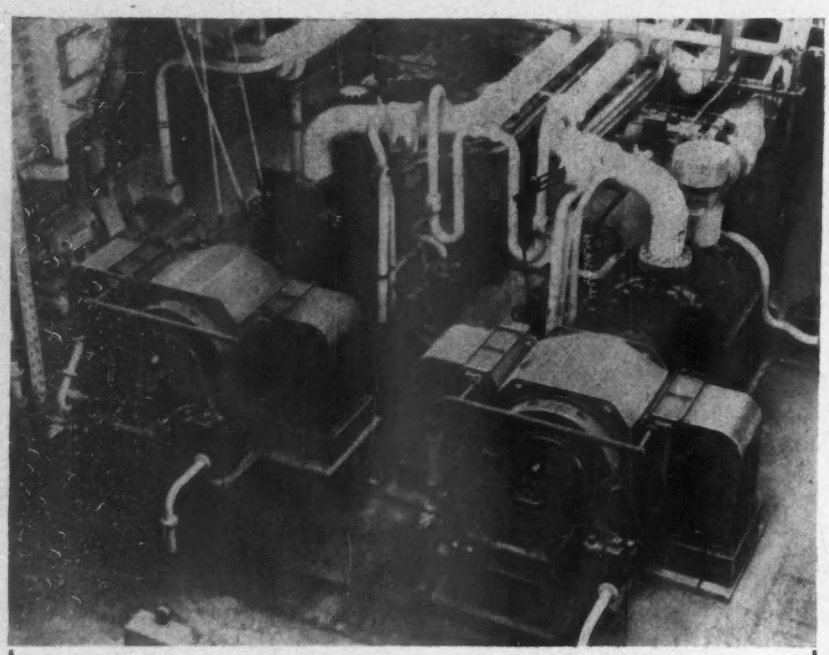

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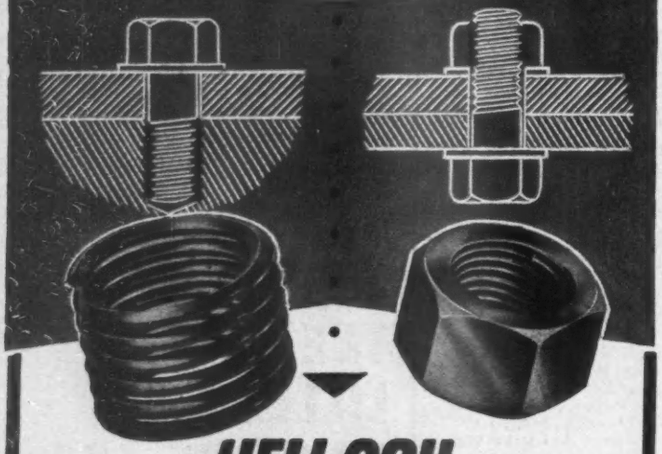

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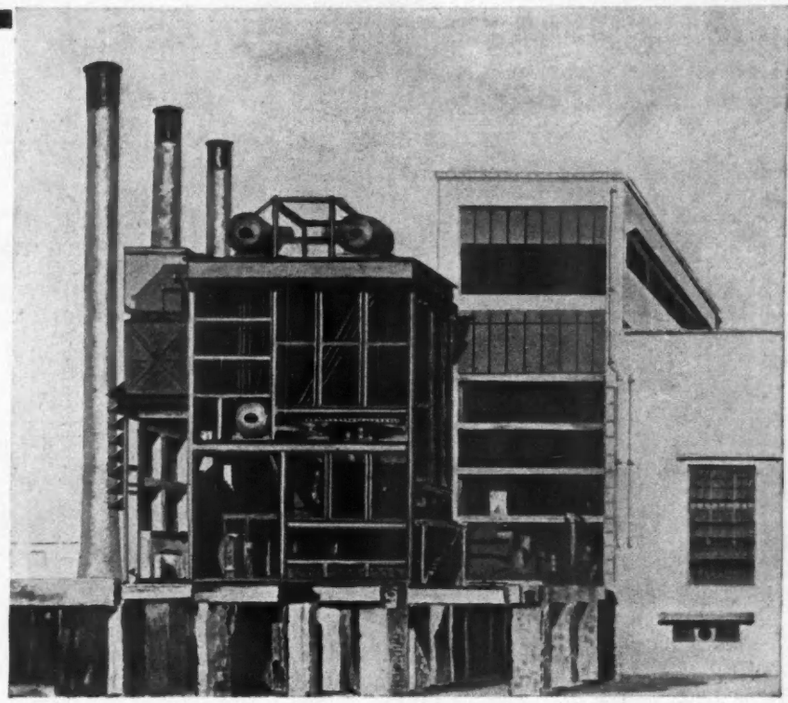

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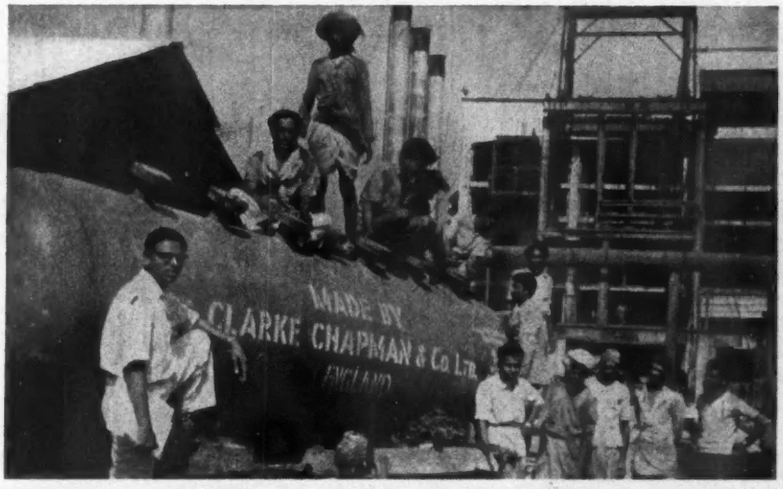

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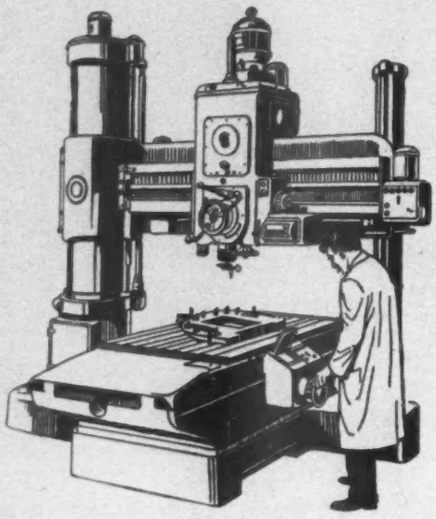

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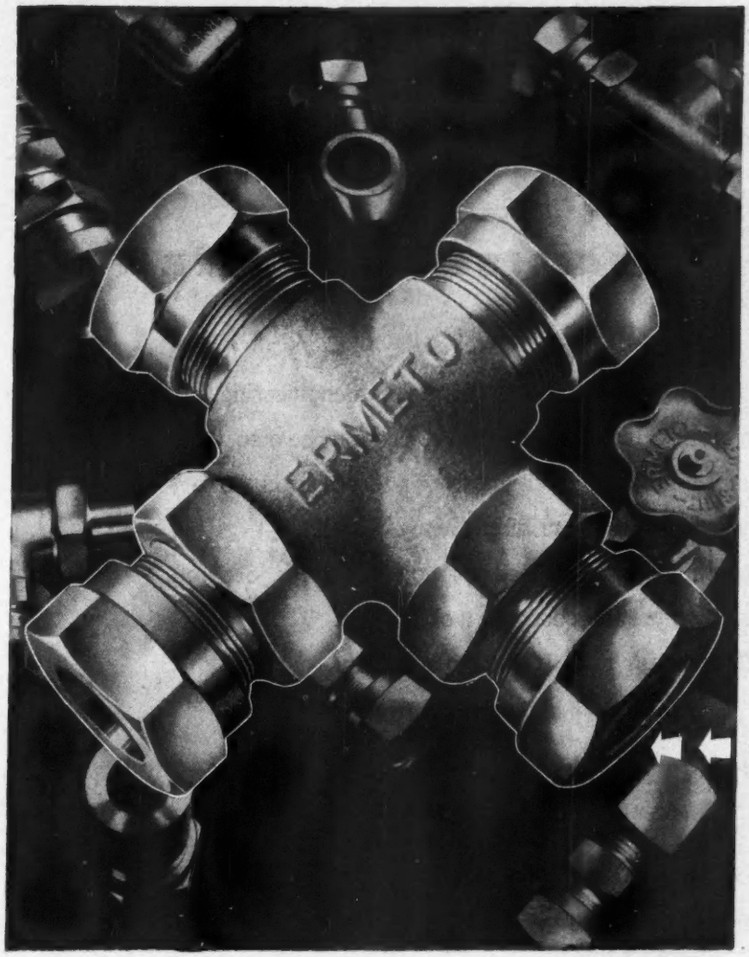

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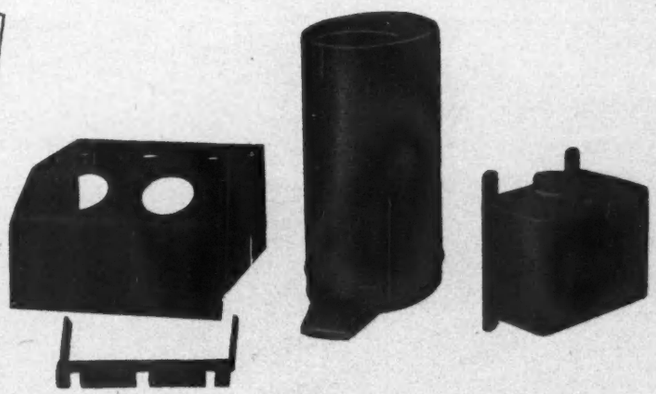

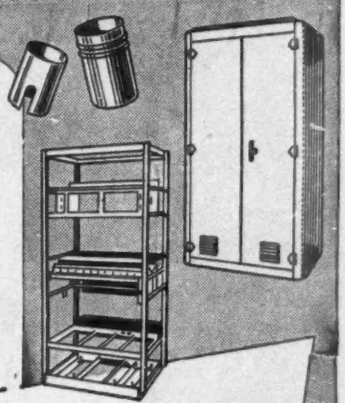

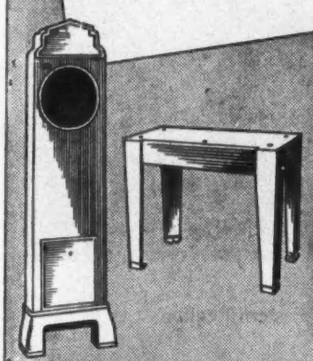

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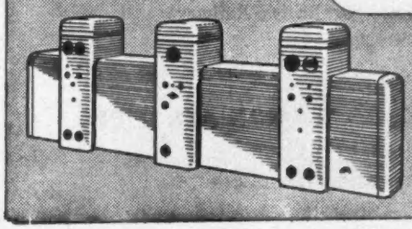

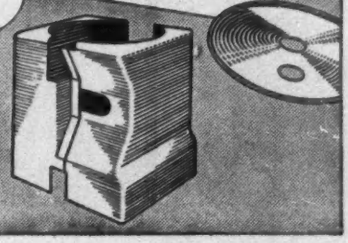

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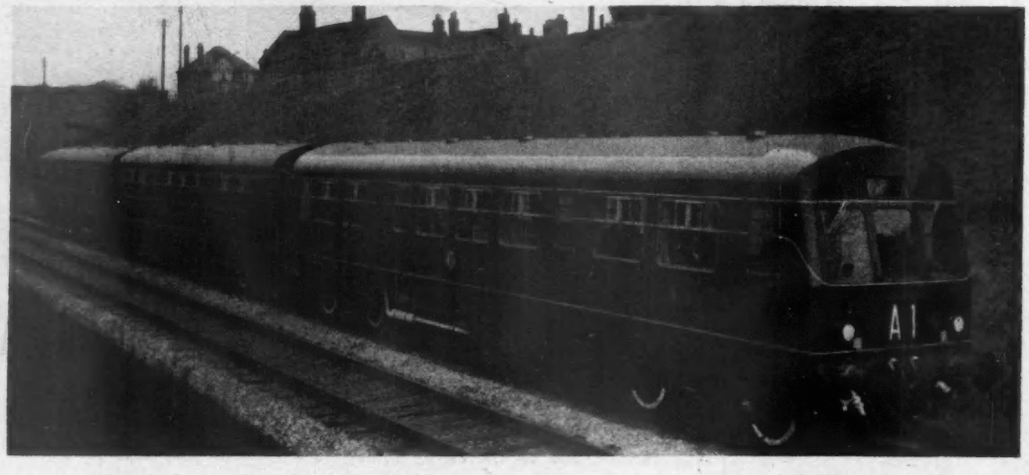

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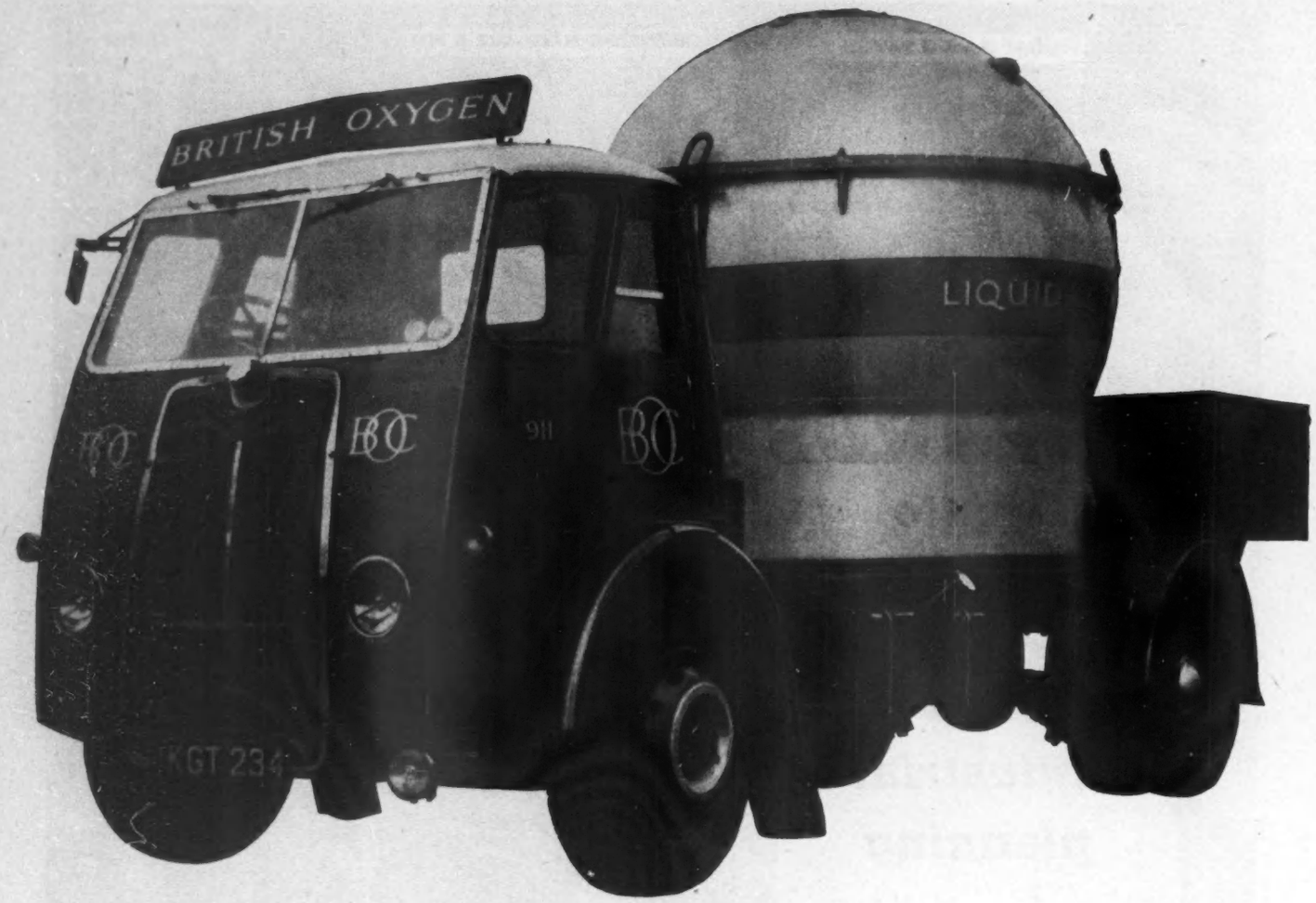

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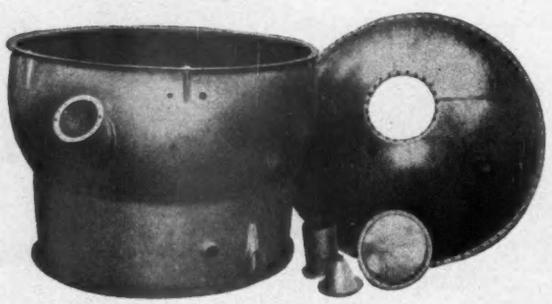

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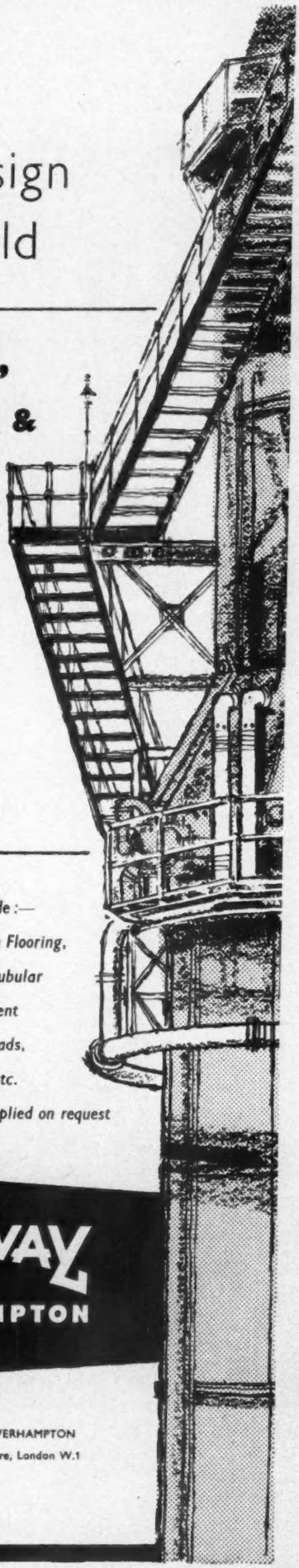

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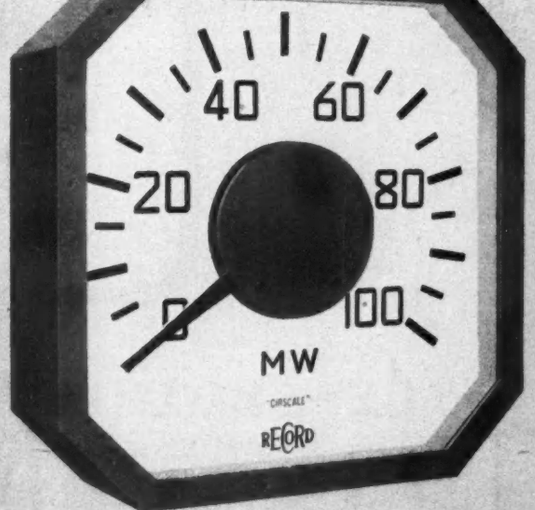

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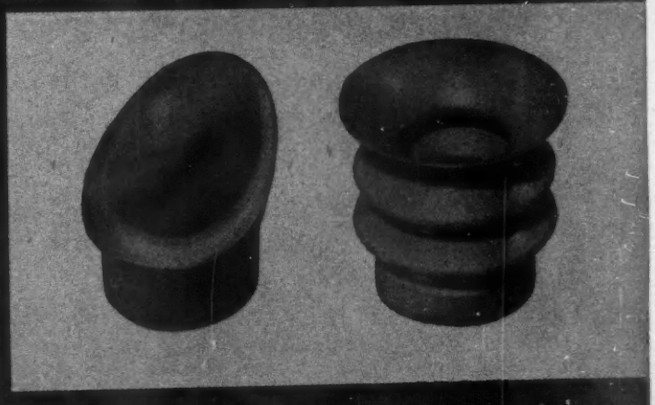

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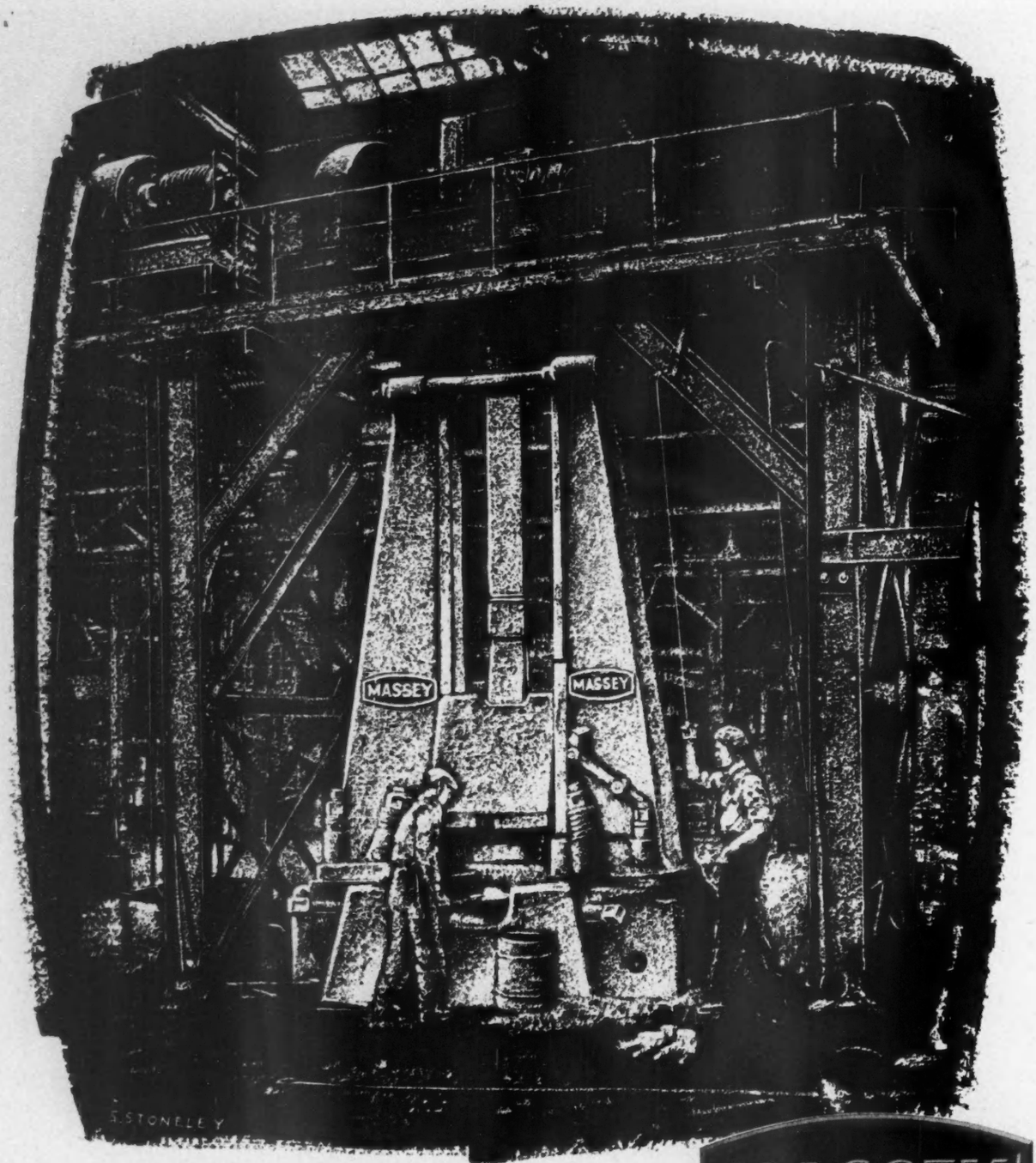

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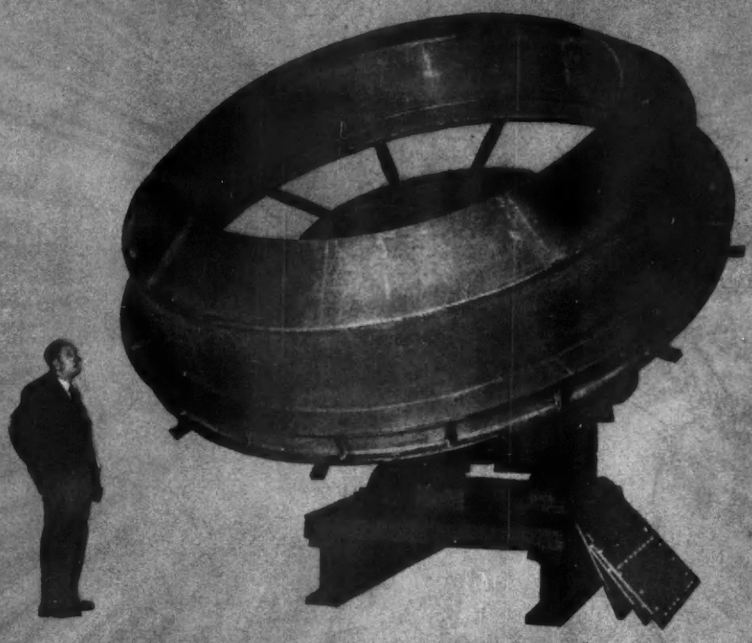

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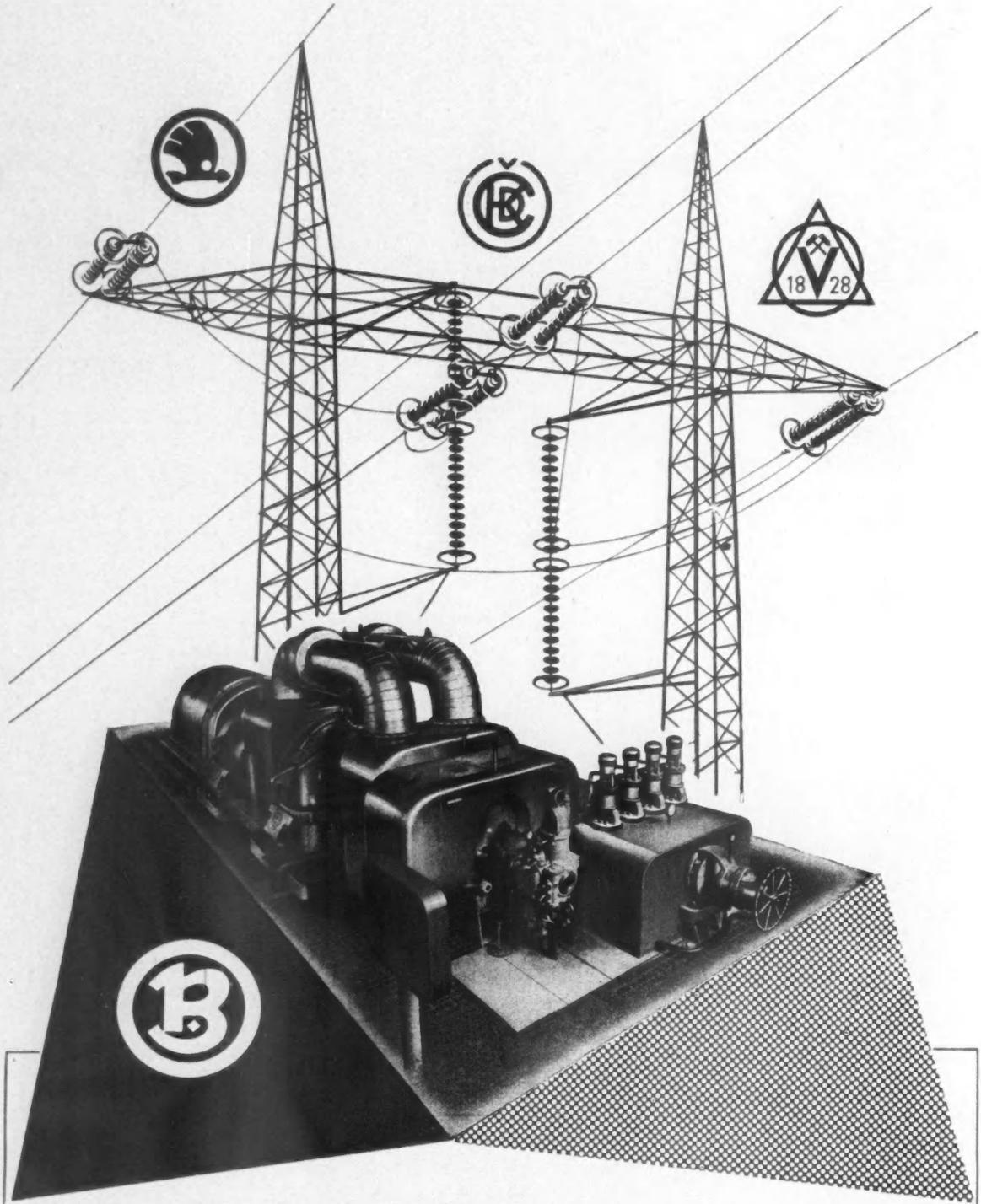

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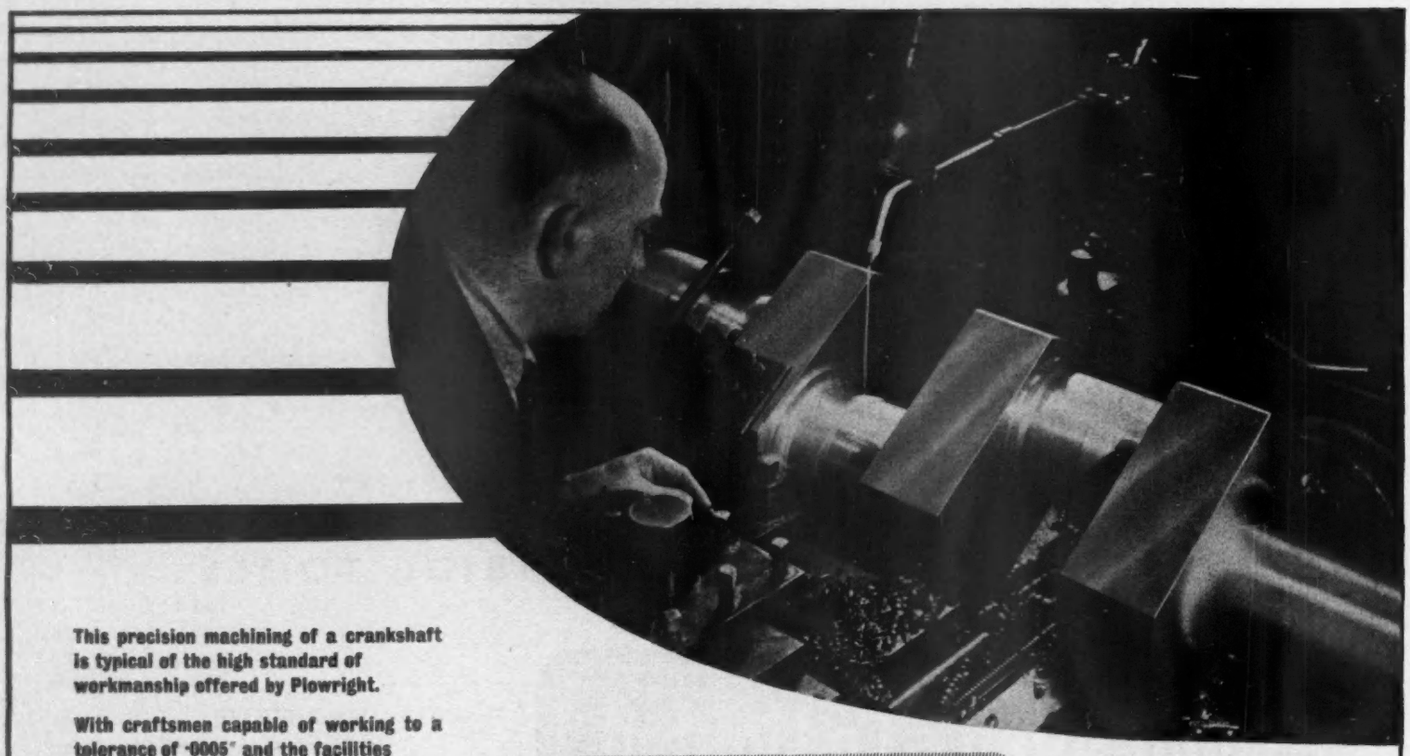

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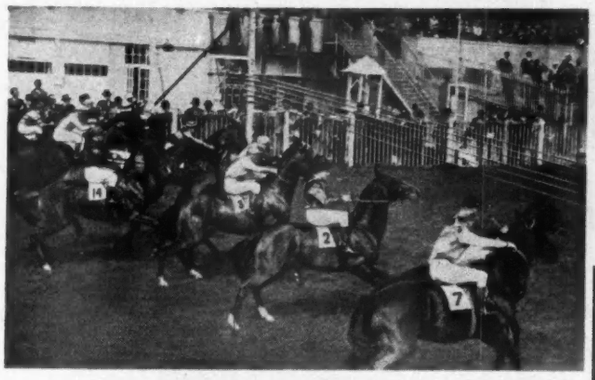

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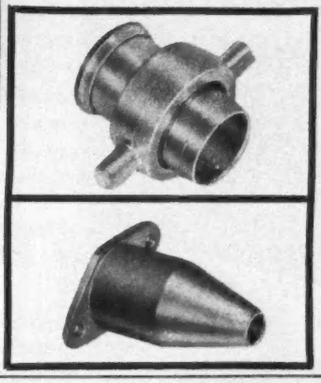

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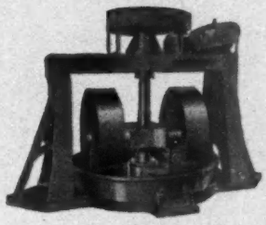

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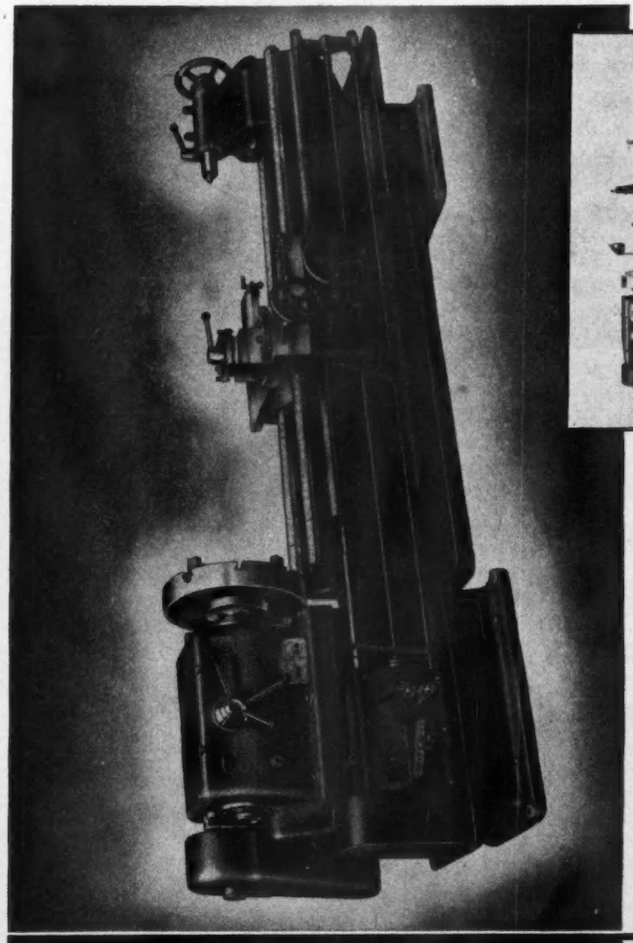

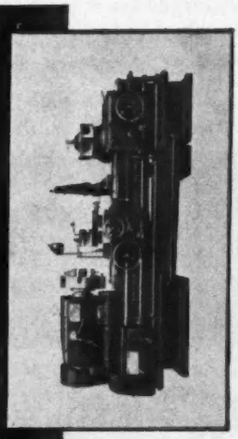

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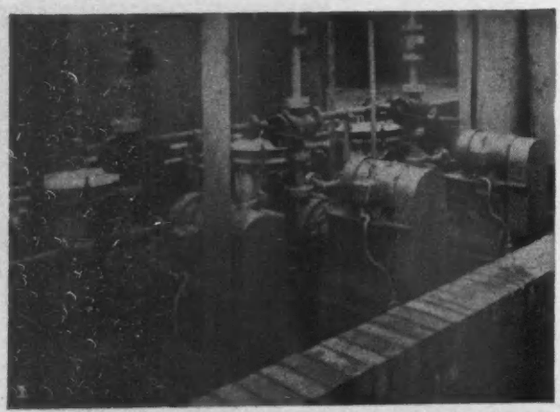

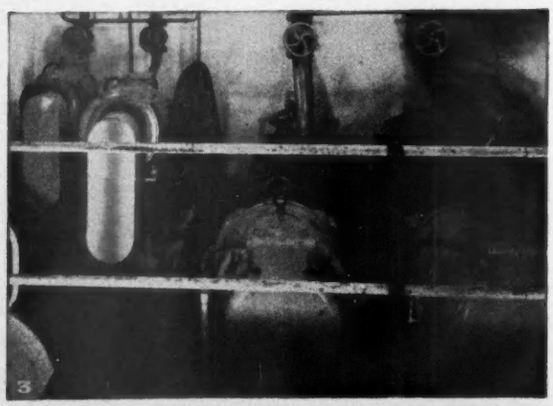

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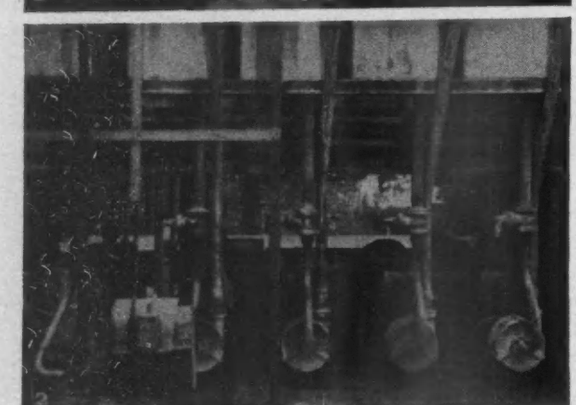

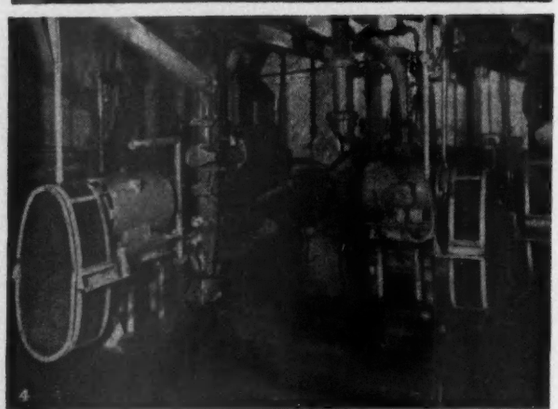

1 *3-1½" model A Rouge pumps.*
2 *4-2" Pumps and 1-1" pump on an experimental rig.*
3 *2-8" and 2-3" Sand pumps at Windle Sand Wash.*
4 *4-5" Sand pumps on grinders.*

P.55

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Robustness, efficiency and simplicity are important characteristics of Sykes Dewatering Equipment, with which contractors' staffs can carry out extensive dewatering of open excavations and trenches without the need for constant supervision.
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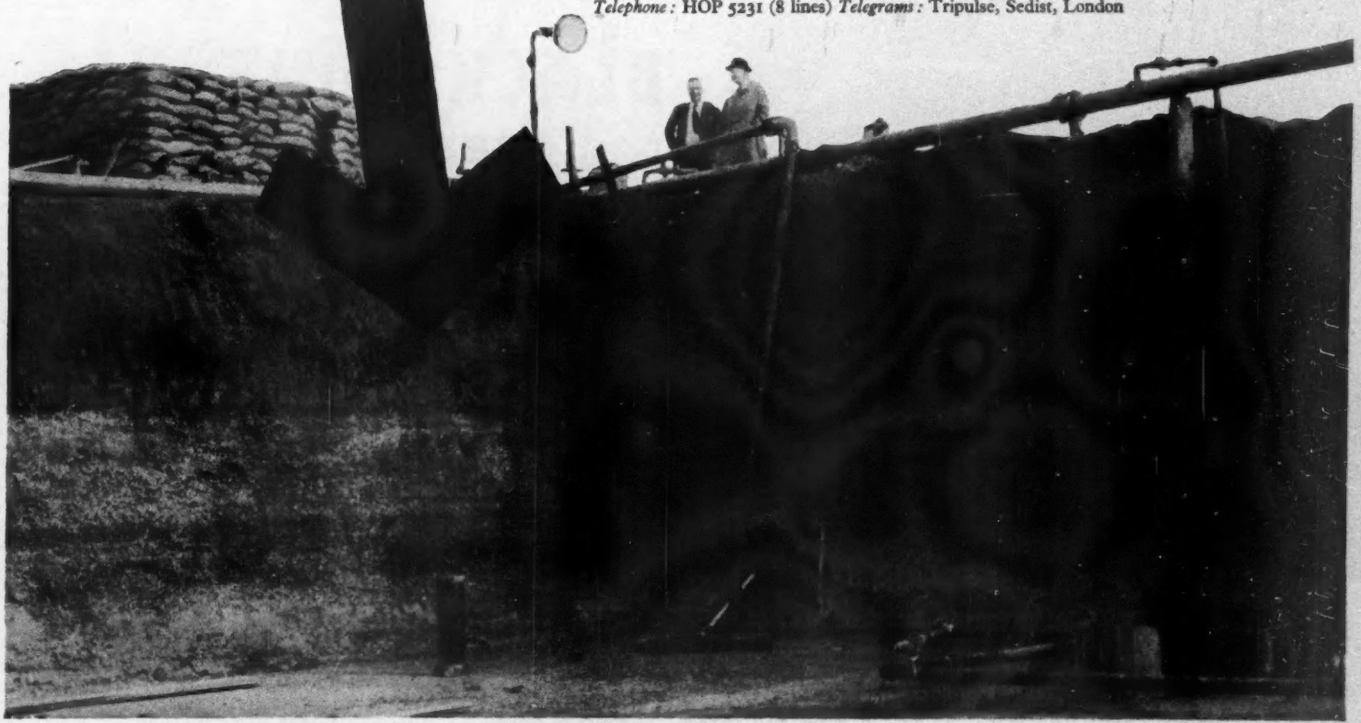

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STEIN *Refractories*

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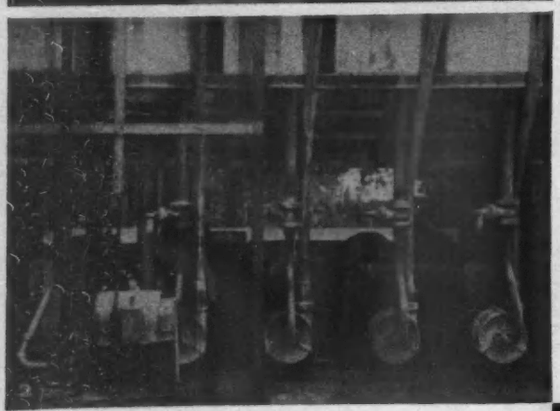

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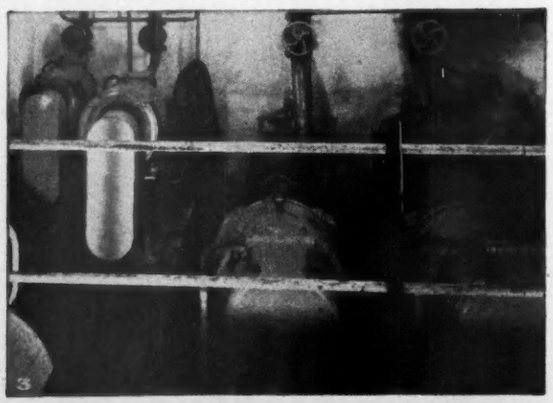

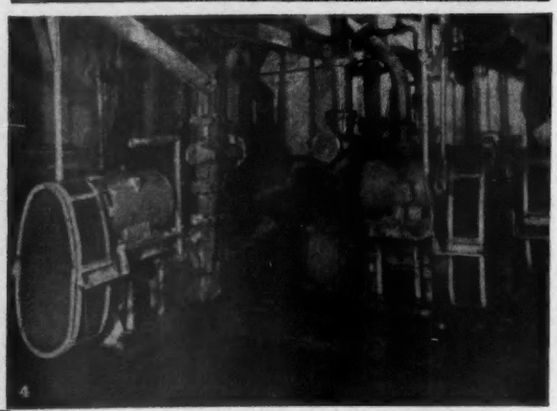

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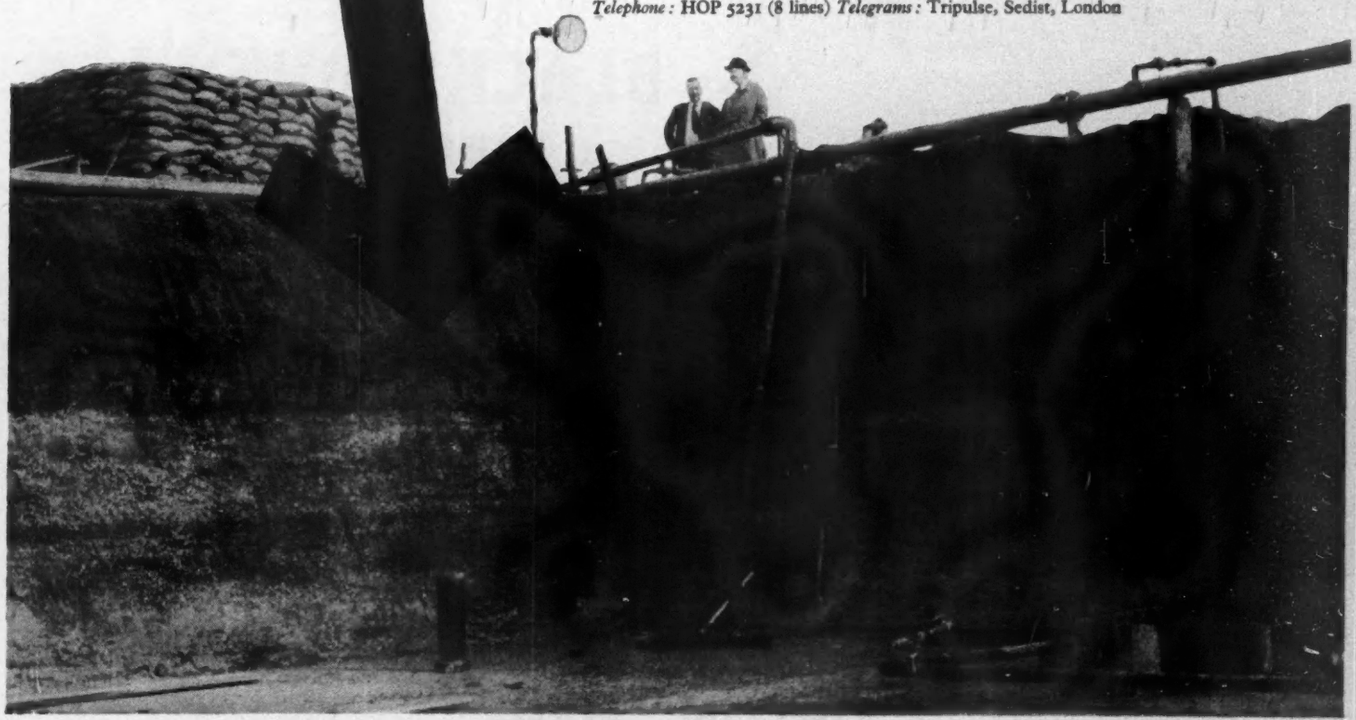

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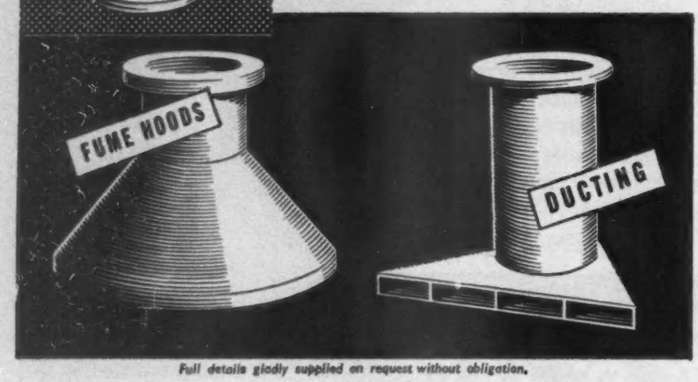

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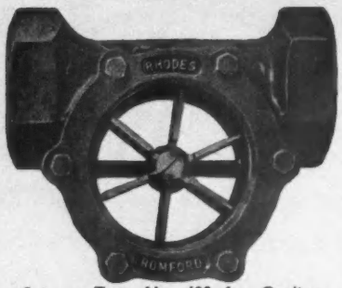

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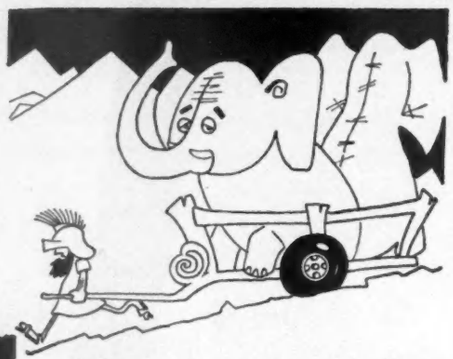

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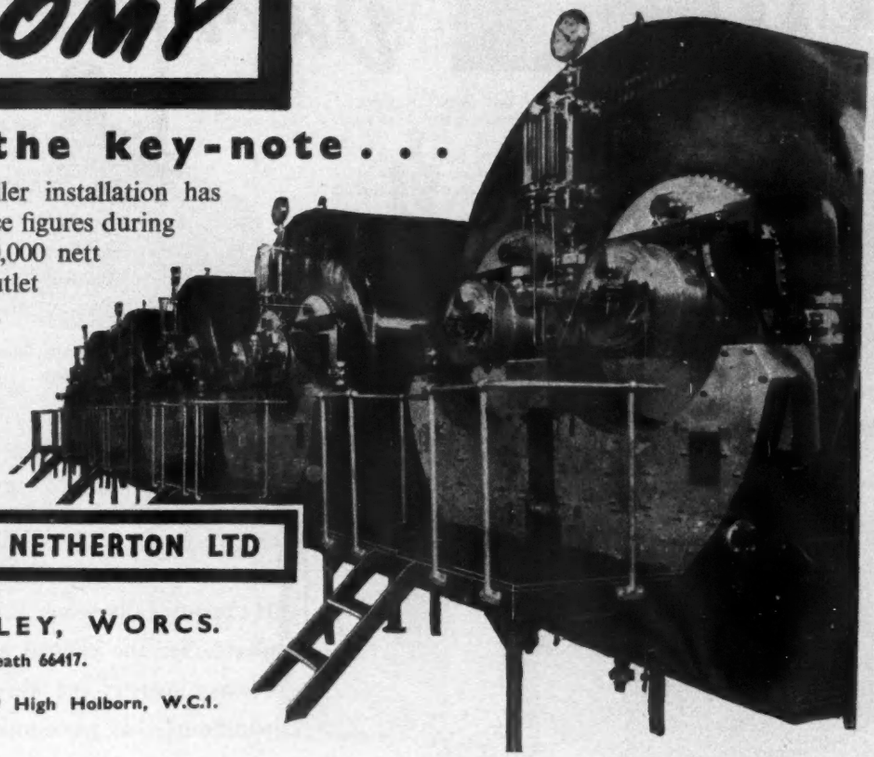

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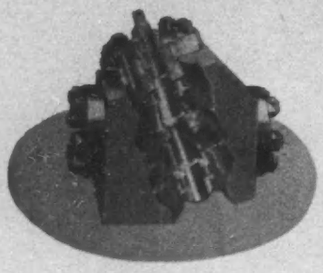
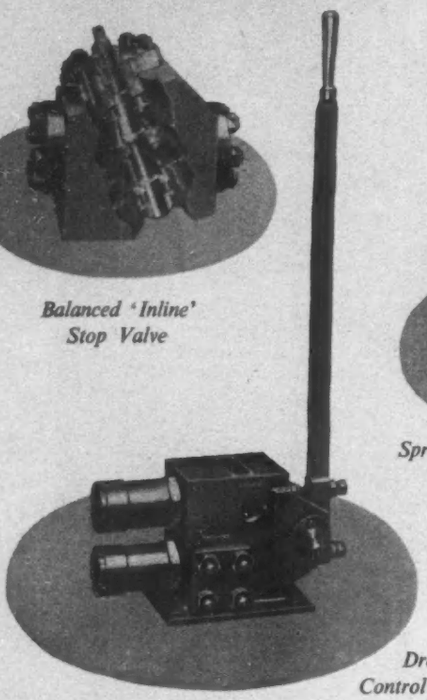
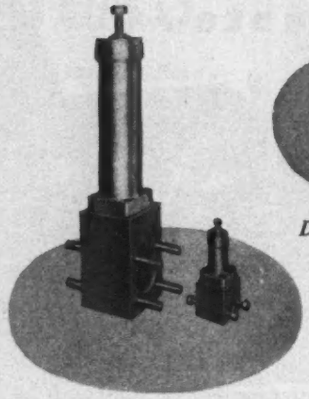


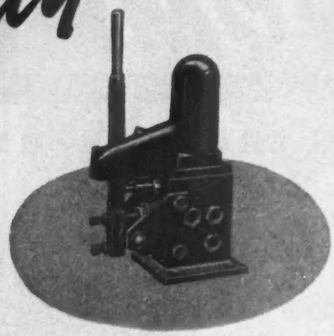
Balanced 'Inline' Stop Valve



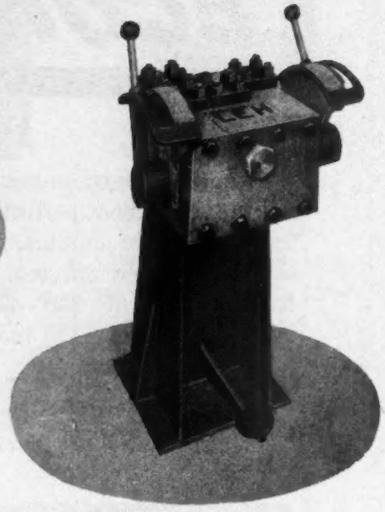
Drop Mitre Control Valve



Spring Loaded Relief Valves



Drop Mitre Control Valve With Trip Gear



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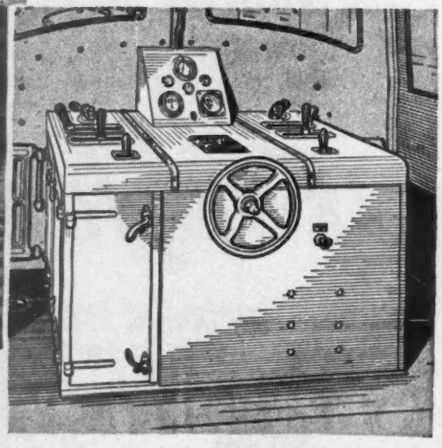

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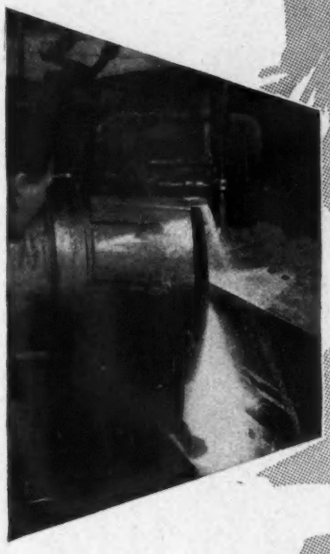

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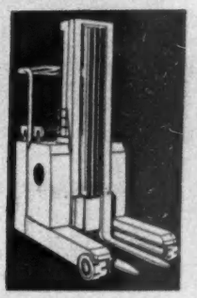

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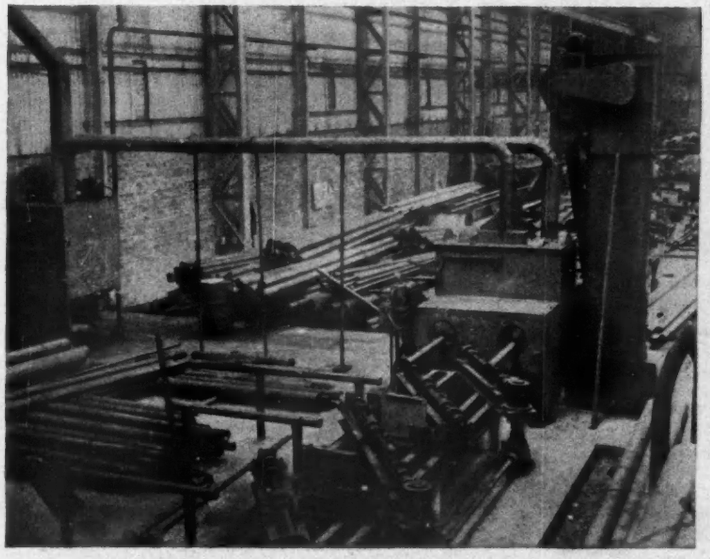

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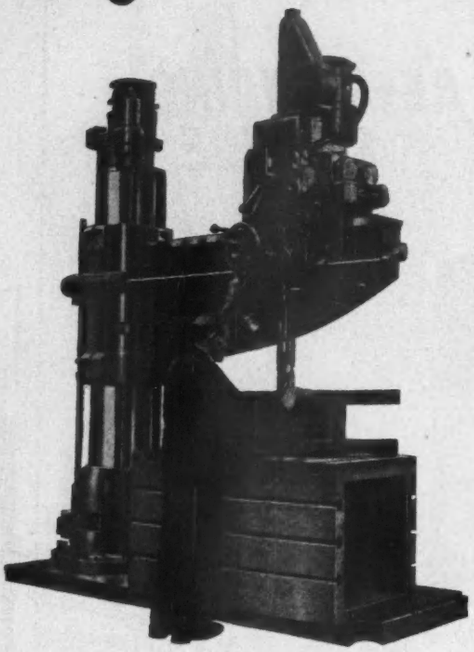

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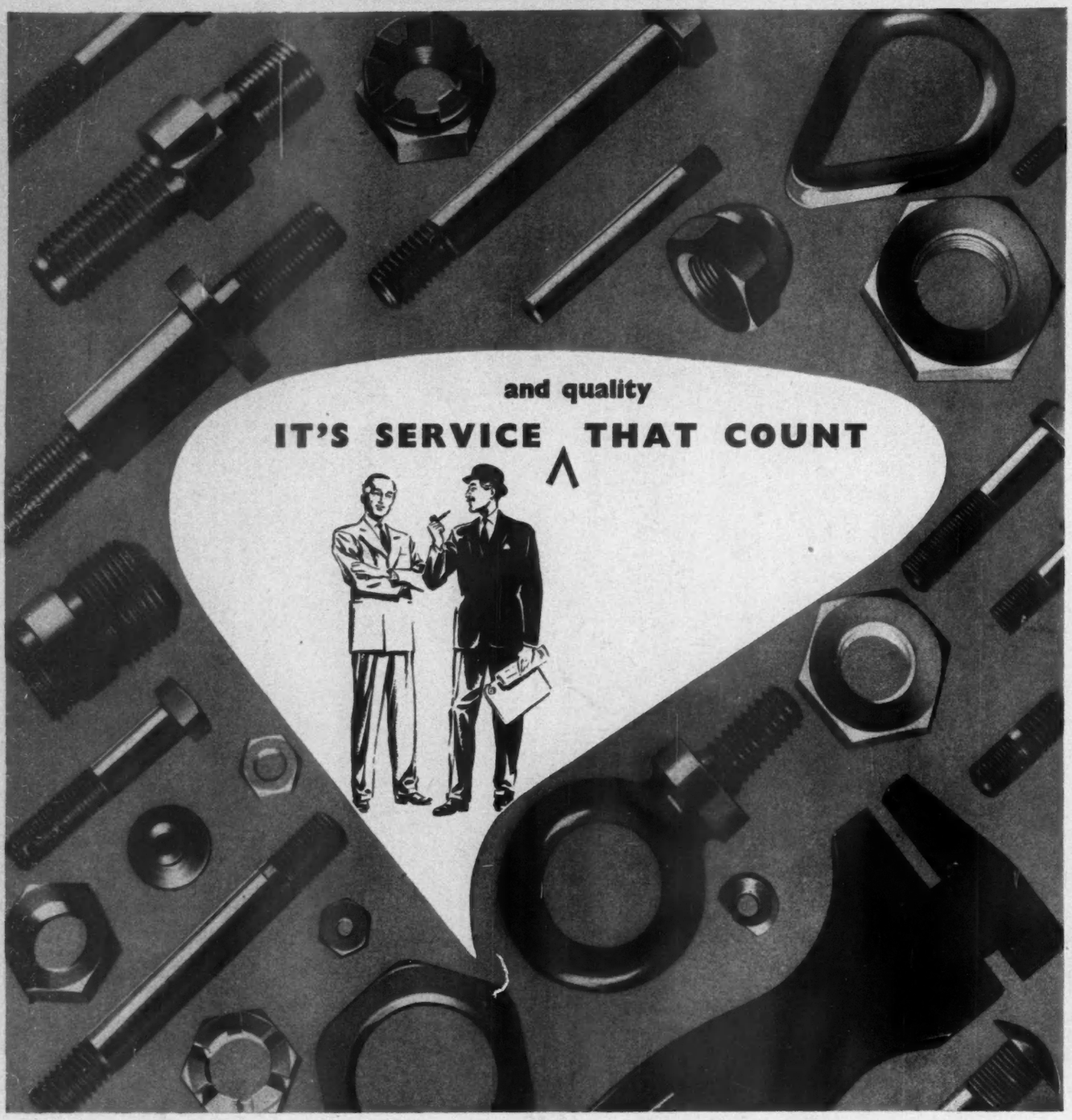

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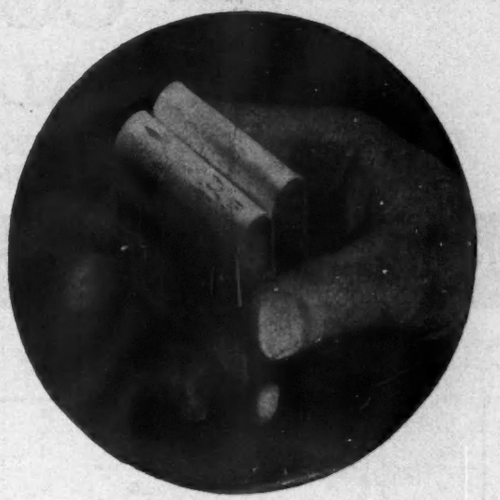

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Class	Grade											B.S.S. 1452/1956	A.S.T.M.	
HIGH DUTY ENGINEERING	E	14	26	56	10	170–190	12–15	7·20	—	—	5·0	14	25–30	1/10
	D	17	30	68	15	180–210	16–18	7·25	—	34,000	7·0	17	35–40	1/10
	C	20	36	75	20	200–240	18–20	7·40	—	51,000	9·0	20	40	1/8
	B	23	40	80	25	220–280	18–20	7·45	—	60,000	10·0	23	50	1/8
	A	26	45	90	30	260–340	18–20	7·45	—	73,000	11·0	26	60	1/8–3/16
HEAT RESISTING	HR.1	14	26	56	10	100–170	10–12	7·00	12·8	—	—	—	—	1/10
	HR.2	20	36	75	20	200–240	18–20	7·40	12·8	—	—	—	—	1/10–1/8
	HR.3 (Silal)	12	—	—	—	210–280	17–45	6·9–7·2	12·9	—	—	—	—	1/8
WEAR RESISTING	W.R.B.	20	36	75	20	240–280	18–20	7·40	—	—	—	—	—	1/8
	W.R.A.	26	45	90	30	260–340	18–20	7·45	—	—	—	—	—	1/8–3/16
CORROSION RESISTING	C.1	18	30	62	10	180–210	12–15	7·15	—	—	—	—	—	1/10
	C.2	15	28	58	10	180–210	12–15	7·15	—	—	—	—	—	1/10

TYPICAL APPLICATIONS OF "CORTITE" SPECIAL PROCESS IRONS

CORTITE IRON		TYPICAL APPLICATIONS	Minimum Casting Thickness	HEAT TREATMENT (optional)
Class	Grade			
HIGH DUTY ENGINEERING	E	Gear Cases, Light Valves, Gears, Electrical Components, Bogie Wheels, etc.; in fact, wherever a soft grey iron is called for.	1/8"	For stress relief heat slowly to 450°–500° C. Hold at this temperature for one hour per inch of section. Cool slowly.
	D	Valve Bodies, Gates, Covers, Medium Machine Bedplates, Chucks, Gears, and Housings; Cylinder Liners, Blocks, and Manifolds. All medium size high-pressure castings.	1/4"	
	C	Turbine Casings, Condenser Bodies, Tyre Moulds, Marking-off Plates, Propellers, Flywheels, Pump Bodies, Pistons, Large High-pressure Valves, Steam Chests, Biological Shields, Gears, Large Machine Bedplates, Headstocks, etc.	3/8"	For improved strength and toughness oil-quench at 850° C and temper at 300°–500° C to remove quenching stresses Grades C and B only.
	B	Diesel and Compressor Bodies (handling high-pressure ammonia and Freon gas), High-pressure Valves, Oil Well Castings, Slush Pumps, Gears, Machine Tool Components, Rocking Links, Highly Stressed Hydraulic Castings, Winch and Winding Drums, Rolls, etc.	1/2"	
	A	Crankshafts, Camshafts, Mixershafts, Dies, Rolls, Atomic Engineering Pressure Vessels, Shields, and Casings; Brake Drums, High-pressure and High Strength Castings.	1/2"	For high tensile and machinability can be held at 300°–350° C, for six hours plus one hour for each inch of thickness.
HEAT RESISTING	HR.1	Intermittent Heat and Severe Thermal Shock, Chills, Ingot Moulds, Slag Pots, Annealing Glass Moulds, Fire Doors, Casings, Pig Moulds, Melting Pots, etc.	3/8"	—
	HR.2	High Duty Castings for use at temperatures up to 550° C, High-pressure Valves, Superheater Headers, Glass Moulds, etc.	1/2"	—
	HR.3	Castings working at temperatures up to 900° C, Valves, Fire Bars, Annealing Boxes, Furnace Parts. These castings are brittle at room temperature.	1/2"	—
WEAR RESISTING	WR.B	Chute Liners, Crane Wheels, Mill Wheels and Blades, Mixing Pans, Gears. Easily machinable.	1/2"	Can be oil-quenched at 850° C and tempered at 300°–500° C.
	WR.A	Mixer Blades, Wheels and Pans, Die Blocks, Cams, Gears, Liners, Rolls. High strength coupled with abrasion resistance.	1/2"	For high hardness castings, to improve machinability hold at 300°–350° C, for six hours plus one hour for each inch of thickness.
CORROSION RESISTING	C.1	Concentrated acid-resistant Pumps, Valves, etc.	1/4"	—
	C.2	Alkali-resistant Pumps, Valves, Caustic Pots, Evaporators, etc.	1/4"	—

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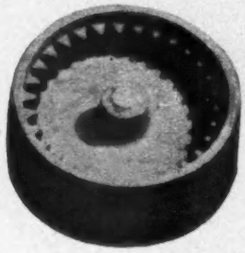


GEAR DRUM—GRADE E
These teeth must be cast true. They are not machined and must mesh perfectly.

CORTS THROTTLE VALVE—GRADE C.

PUMP CASTING—GRADE D.—(For Hayward, Tyler & Co., Ltd., Luton).

This 53 cwt. Vertical Compound Oil Cargo Pump is for use in tankers and handles 750 t.p.h. of oil. It is tested at 350 lb. p.s.i. for a working pressure of 200 lb. p.s.i.

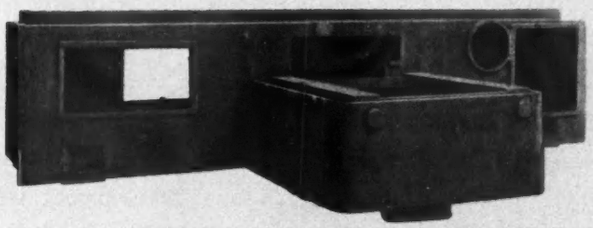
All the cores and the mould are made by the CO_2 process, which gives an excellent finish and ensures that the dimensions of cored holes are exact.

COMPRESSOR CYLINDER FOR REFRIGERATION EQUIPMENT—GRADE B.—(For Lightfoot Refrigeration, Ltd., Wembley).

This 15½ cwt. six-cylinder freon compressor casting must be completely flawless. The cylinders and crankcase, which are cast in one piece to ensure perfect alignment, are subject to hydraulic tests of 300 and 600 lb. p.s.i. respectively and gas tests of 250 lb. p.s.i.

MIXERSHAFT — GRADE A.—(For Winkworth Machinery, Ltd., Staines).
This Casting must be very strong, and 100% sound, to withstand severe Torque, replacing a steel casting.

CORTS DOUBLE GATE VALVE—GRADE HR.2
For use in hot gas main at temperatures of 550°-600° C.



BEDPLATE FOR GEAR CUTTING MACHINE—GRADE C.—(For W. E. Sykes, Ltd., Staines).

This 3-ton, 12ft. long bedplate casting is only ¾in. thick and requires a very accurate mould and core, which, again, is achieved by the use of CO_2 process. Over 50 cores are needed to produce the intricate internal chambers.

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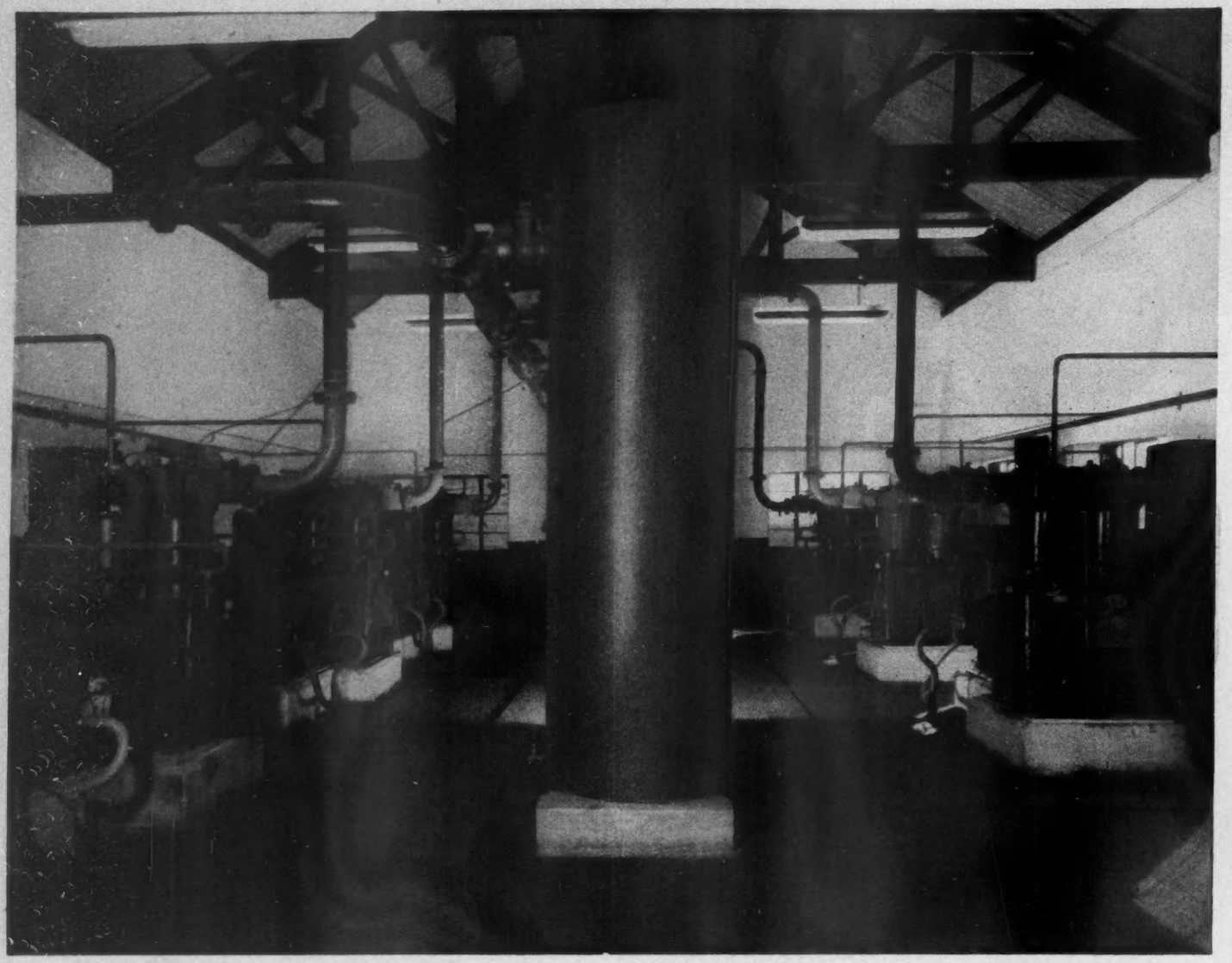

Each of these EH 241 Air Compressors delivers 330 cu. ft. free air per minute

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A battery of seven " BROOMWADE " EH 241 Stationary Air Compressors is used for sandblast-finishing many of the Fletton bricks made at the Ridgmont works of the Marston Valley Brick Co. Ltd.

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colour galbestos

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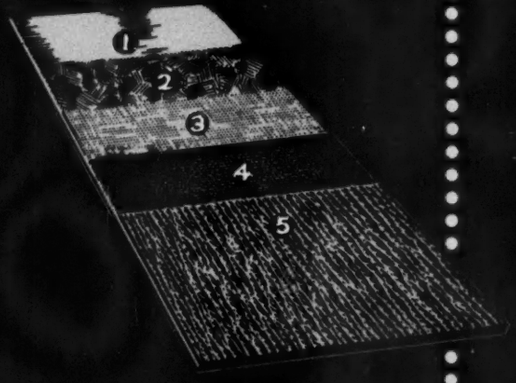
Resistance to corrosion, minimum maintenance and long-life are qualities which have been proved in Galbestos Protected Metal by decades of service in industries of every kind.

Now after years of research and the most stringent tests Robertson Thain announce Colour Galbestos, a product which allies the beauty of colour to the well known advantages of Galbestos Protected Metal.



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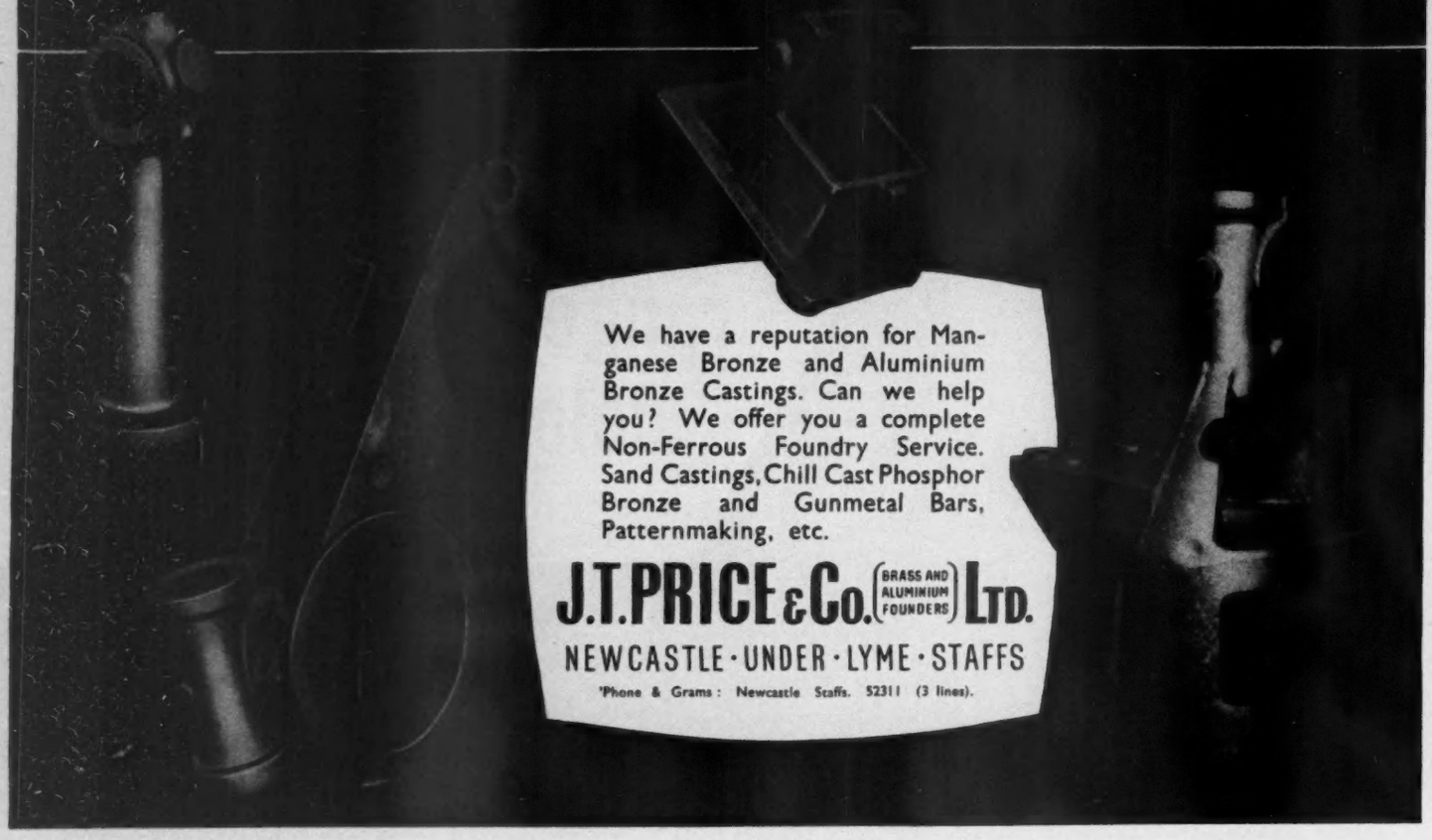

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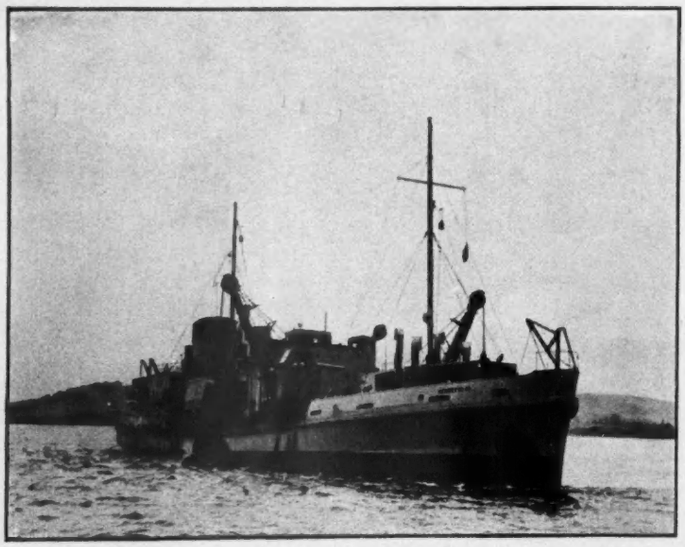
The largest Grab Hopper Dredge in world-wide service to-day



and, as you might expect, it was built by Lobnitz of Renfrew. A twin screw Grab Hopper Dredge powered by Diesel engines, the four Grab Cranes are electrically operated. The dredge was recently delivered to the Mersey Docks and Harbour Board.

Harbour Authorities all over the world respect the high efficiency of Lobnitz craftsmanship, and avail themselves of this Clydeside firm's wide technical experience.

Lobnitz THE NAME TO REMEMBER IN DREDGING

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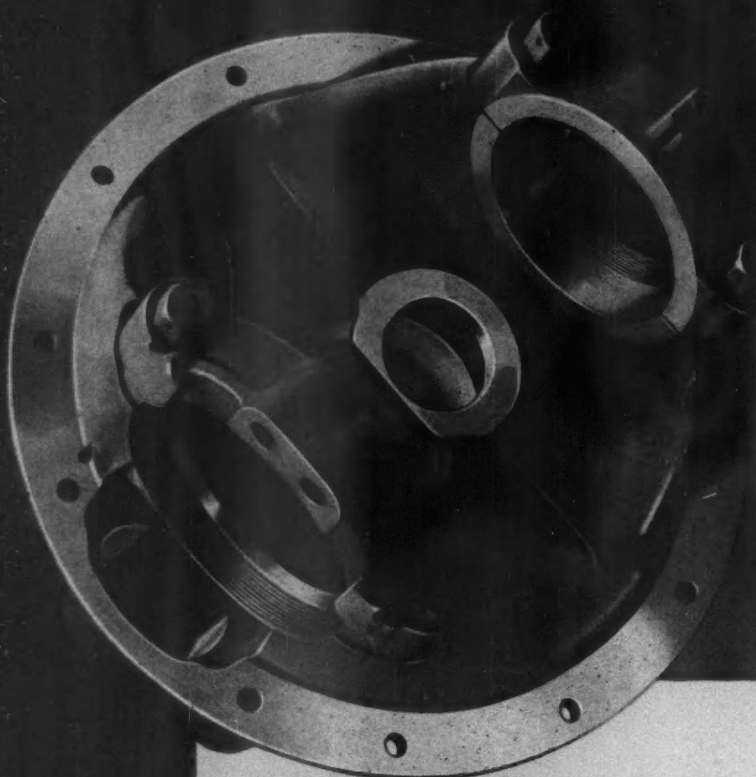
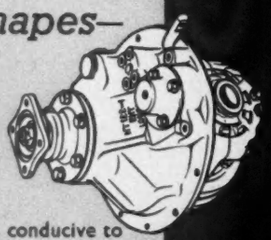


RIGIDITY–

with complex shapes–



LEY'S 'Black Heart' free-machining malleable iron offers considerable latitude to the designer, for the metal can be cast into practically any desired form, and be placed exactly where needed to meet mechanical requirements, at the same time providing the greatest rigidity.

The housing shown here makes excellent use of Ley's 'Black Heart' malleable iron in providing this rigidity, so necessary in a rear axle application, combined with an inherent damping conducive to quiet running. In addition, the casting has great toughness and resistance to shock.

'Lepaz' pearlitic, another Ley's malleable, combines still greater mechanical strength with easy machining. It responds readily to subsequent heat-treatment (including induction heating) which will provide mechanical properties within a wide range of requirements.

A typical high duty specification met by heat-treated 'Lepaz' is as follows :

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LEY'S

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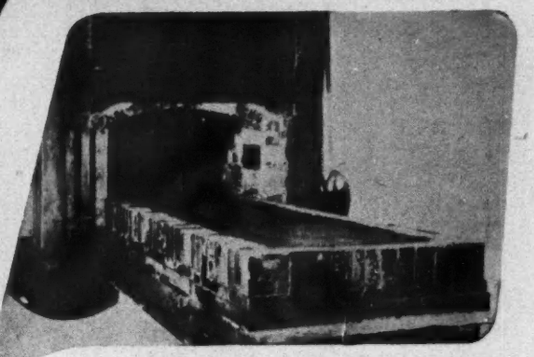
EUROPE'S LARGEST MALLEABLE PRODUCERS

BOGIE TOPS

Examples of another of the many uses for

REFRACTORY CONCRETE

Atlas Steel Foundry. Bogie for mould drying stove, topped with Refractory Concrete. Bogie is 25' long and 10' wide, the topping being 6" thick. The door shown is lined with Ciment Fondu insulating concrete



Wm. Jessop & Sons Ltd. Bogie is 15' long by 5 wide topped by 6½" of Refractory Concrete

—Because its monolithic construction eliminates troubles due to displacement of bricks

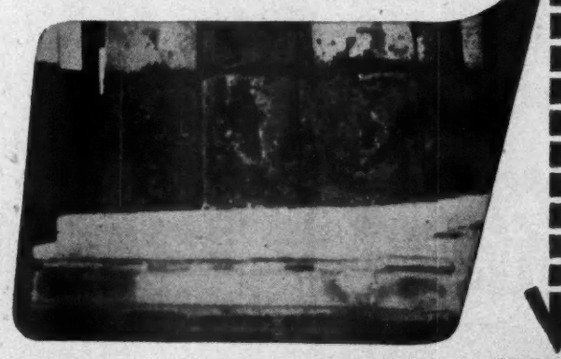
—It will withstand severe thermal shock without spalling

—It is ready for use and of great strength and hardness in 24 hours

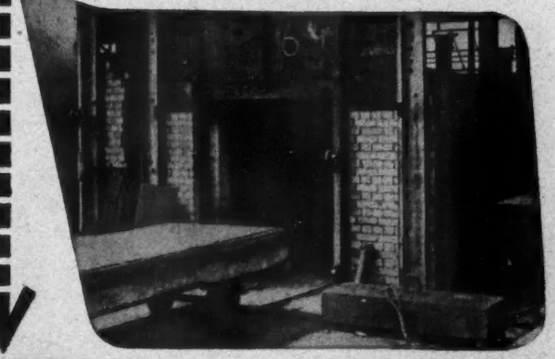
—It has no appreciable drying shrinkage or after-contraction

—It is stable under load up to 1300°C. (2400°F.)

Bogie used at large Northern Foundry, in gas-fired tunnel oven, for annealing malleable iron at 1050°C. Bogie is 7' x 7' and the Refractory Concrete decking is 12" thick.



Crossley Bros. Ltd. Bogie for gas-fired annealing oven operating at 650°C. The door is also lined with Refractory Concrete



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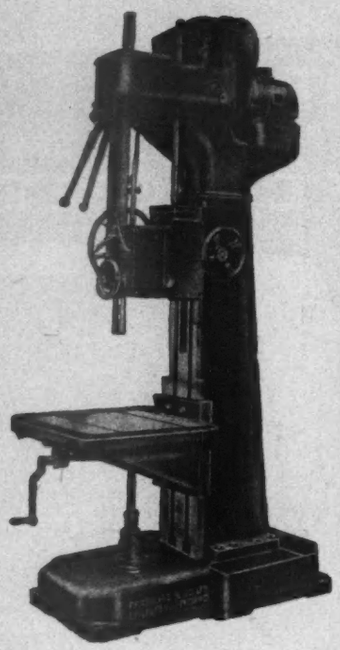

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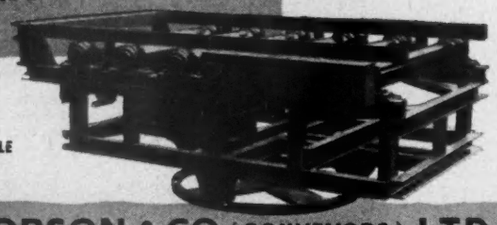

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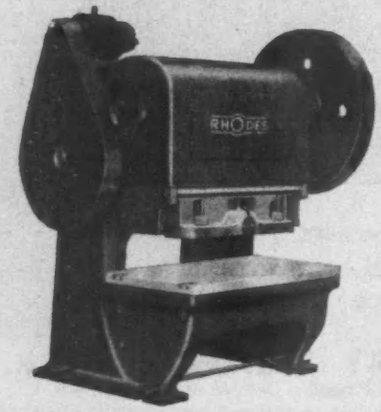

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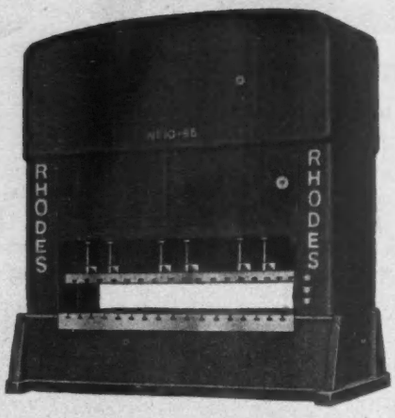

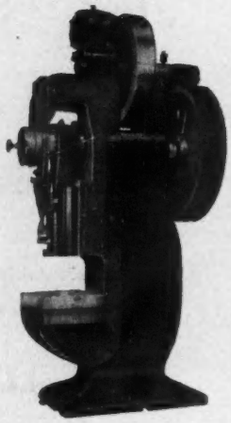

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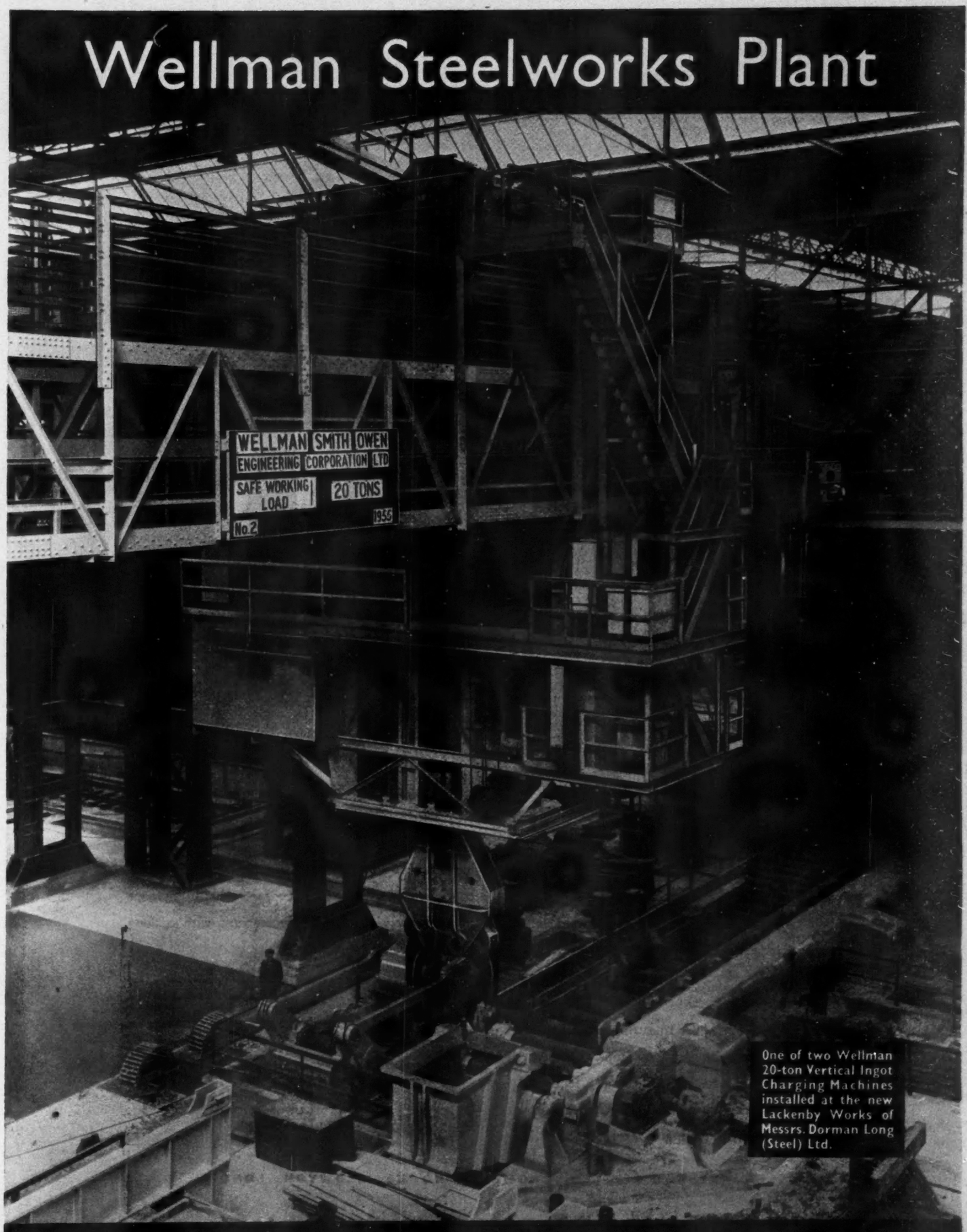
Wellman Steelworks Plant



One of two Wellman 20-ton Vertical Ingot Charging Machines installed at the new Lackenby Works of Messrs. Dorman Long (Steel) Ltd.

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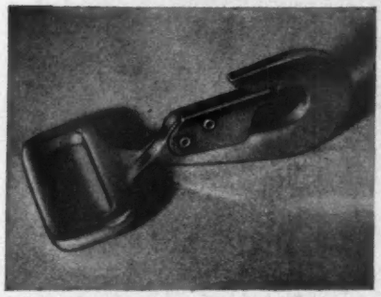
How to select the right alloy

. . . FOR HIGH STRENGTH

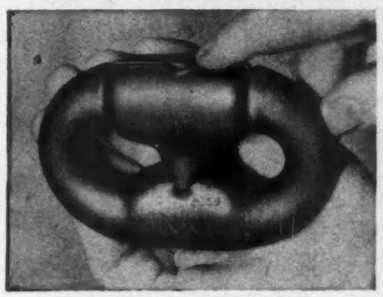


'K' MONEL *snap hook for pilots and observers parachute sets.*

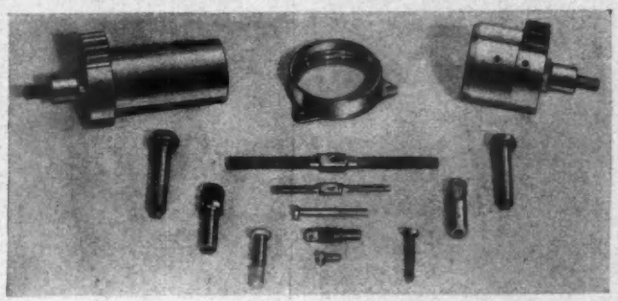
When mechanical strength combined with corrosion-resistance are required, the most suitable material is often one of the wrought high-nickel alloys. Many of these can be heat-treated to give mechanical properties comparable with those of many alloy steels.

'K' MONEL for instance, can be heat-treated to give a tensile strength of 75 tons/sq. in. and a DPN hardness as high as 340. The outstanding strength and hardness of 'K' MONEL have led to its wide acceptance for parts such as pump shafts which often operate under severe mechanical stress in corrosive conditions.

The fact that 'K' MONEL is non-magnetic has led to its use for high strength bolts, rivets, etc., in airframe assemblies where although the strength of alloy steel is required, it is also essential to avoid interference with delicate instruments.



A non-magnetic Anchor Chain link made of 'K' MONEL.



A selection of 'K' MONEL *bolts and rivets used in various parts of aircraft.*

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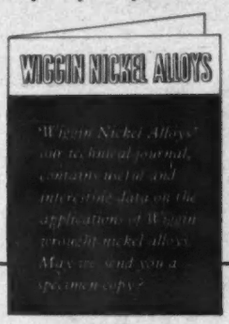
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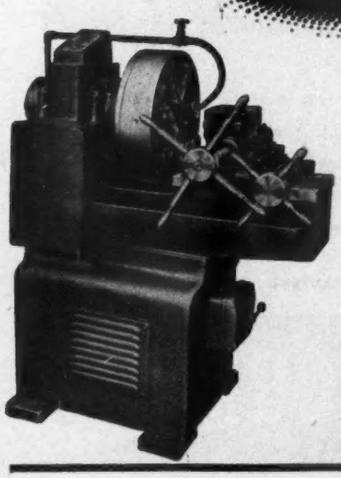

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A general purpose machine, capable of handling a wide variety of Pipe and Bolt work at a very low die cost. Tangential Die Head with quick opening and closing device, . . . no nuts to unscrew.
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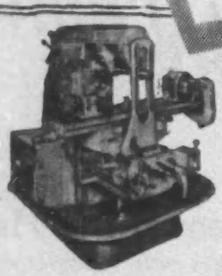

NO. 4 UNIVERSAL MILLING MACHINE

The photograph shows a Richmond No. 4 Universal Milling Machine fitted with Universal Milling head in use at the Halifax Tool Co. Ltd. This machine is all-geared for high speed work to critical limits.

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giving specifications and full technical information of

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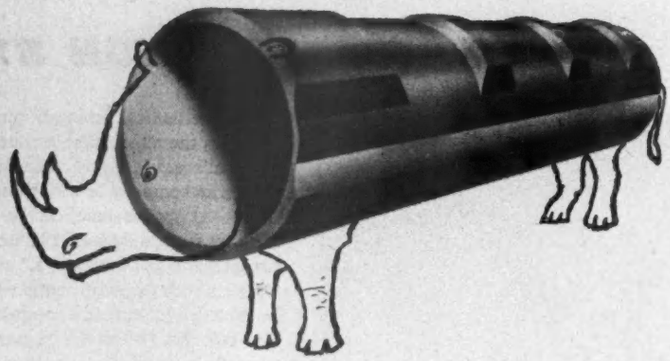

Dash it all—I've fairly peppered the brute and every shot bounces off!

Perhaps a twenty-five pounder is called for.

Doubt whether that would do either. Haven't you noticed . . .

By jove! *Seamless* steel. Not a weld or a weak spot anywhere!

Quite. Let's creep quietly away, old man, before *it* notices *us*.

Chesterfield Tubes

The marine boiler drum illustrated was machined externally to form tube and wrapper plates and pads. It is 14 ft. 6 ins long and has an internal diameter of 30 ins. Tubes of this calibre we take in our stride; in fact, we're game for any size you want.

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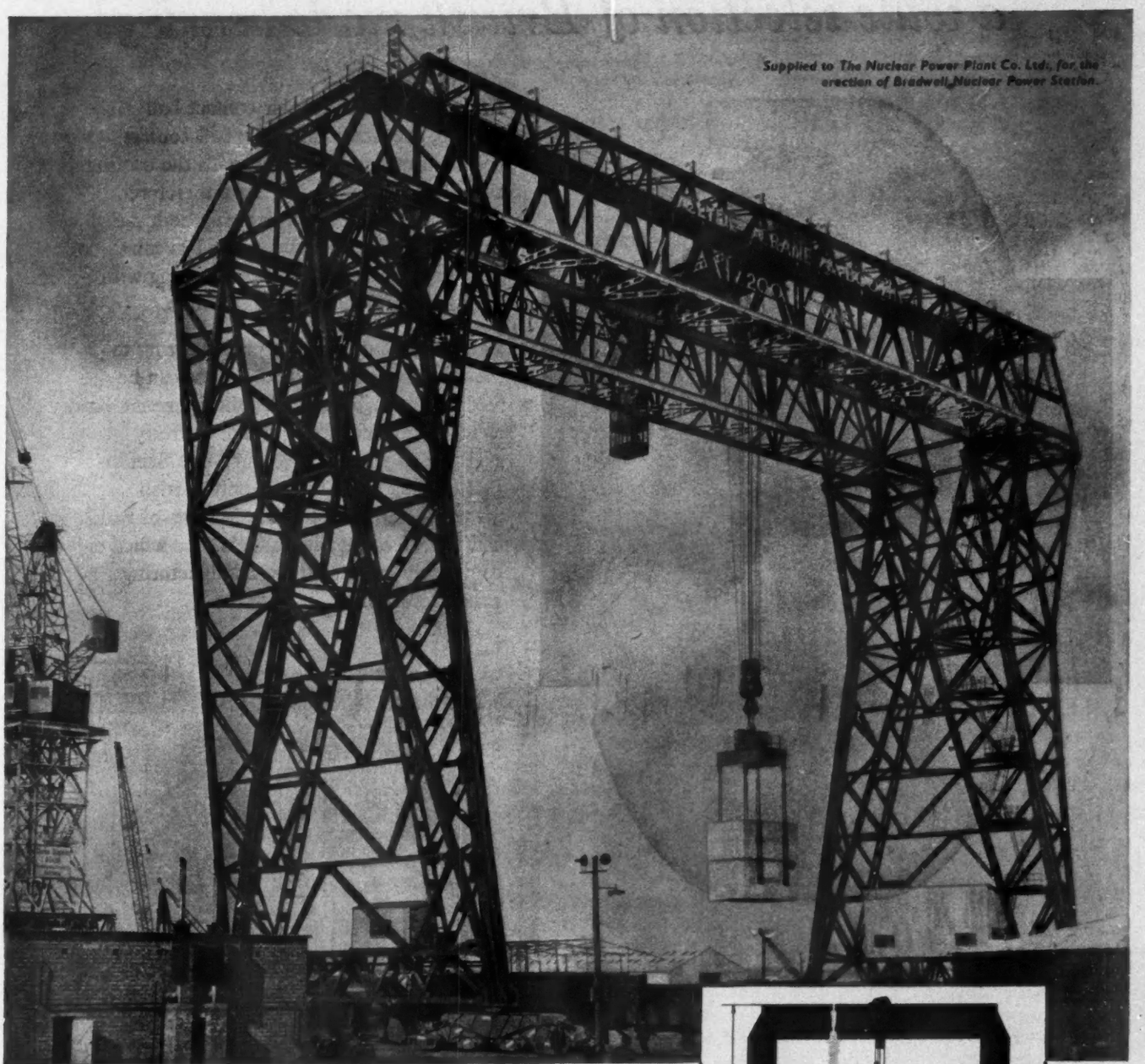
CRC 50

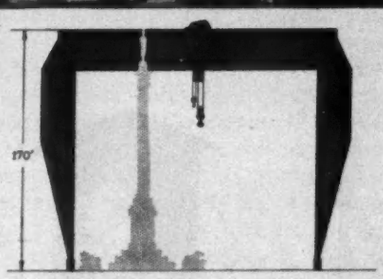
Britains biggest Crane ..

CLYDE-BOOTH 200 TONS GOLIATH



Supplied to The Nuclear Power Plant Co. Ltd., for the erection of Bradwell Nuclear Power Station.

Shown lifting concrete test blocks representing the maximum working load of 200 tons, this Goliath was built by Clyde Crane & Booth Ltd., for the erection of Bradwell Nuclear Power Station. Taking into account the lifting capacity and overall dimensions, it is believed to be the largest of its type in operation in this country and probably the world.



The Booth Goliath showing Nelsons Column on the same scale. Clearance from rail level to underside of bridge is 140'. Distance between rail centres 178'.

CLYDE BOOTH

CLYDE CRANE & BOOTH LIMITED

incorporating

Clyde Crane & Engineering Co.,
MOSSEND, Lanarkshire.
Phone: Holytown 412 (6 lines) Grams: 'Clyde' Motherwell

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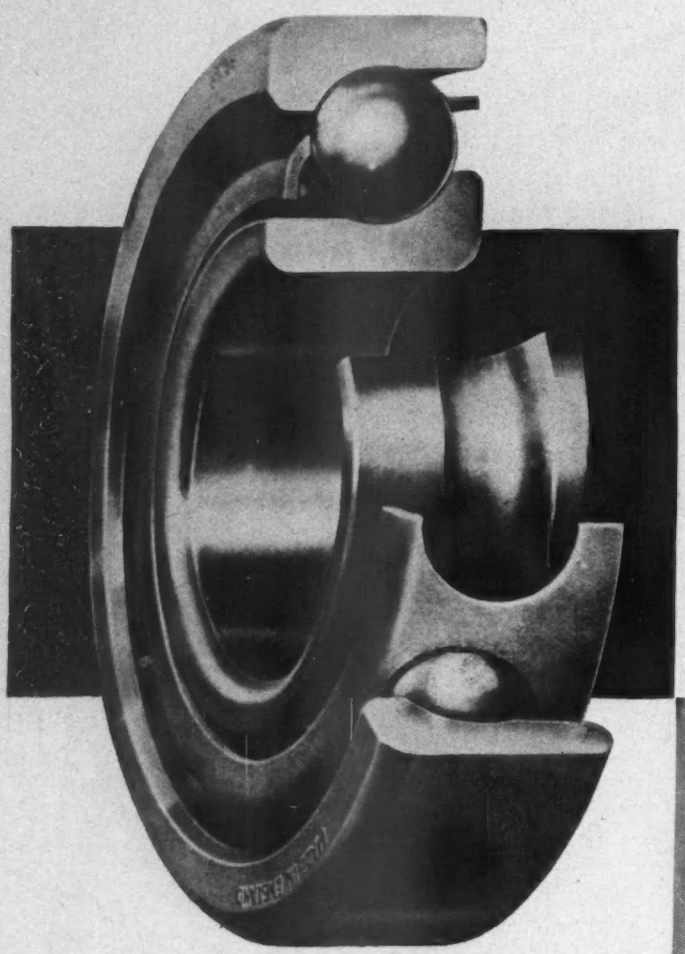
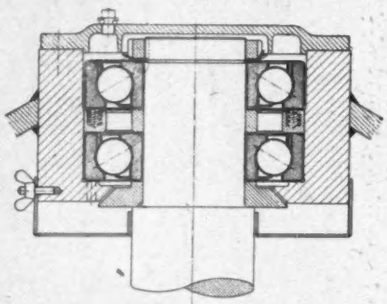
Phone: Pudsey 3168 (6 lines) Grams: 'Cranes' Rodley

Only SKF *can offer such a wide selection of British made bearings*

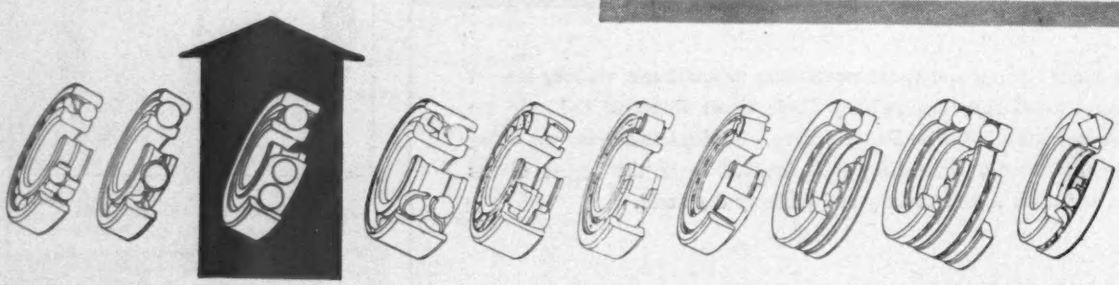


In the single row angular contact ball bearing, the line joining the ball contact points forms an acute angle with the bearing axis. Bearings of this type are therefore particularly suitable for carrying both radial and heavy axial loads, being used in conjunction with a similar bearing dealing with axial forces in the reverse direction.

The problem of which type of bearing to use under given design conditions can be readily solved by utilising the immense fund of technical knowledge which is freely available to you from SKF. The Skefko Ball Bearing Co. Ltd., the only British manufacturer of all four basic types of ball and roller bearing, can offer advice which is completely unbiassed by manufacturing considerations.



Top bearing for vertical electric motor



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THE ENGINEER

No. 5348 JULY 25, 1958 VOL. 206

WORKS TRAINING IN SANDWICH COURSES

There has just been issued by the Institution of Electrical Engineers a report on the " Education and Training of Student Apprentices in Electrical Engineering." By student apprentices the Institution means young men undergoing " a closely integrated course, generally lasting for five years, of theoretical study at a college, coupled with industrial training in manufacture or with an operating concern," effectively, that is, a " sandwich " course and more particularly a course of a character leading to the award of a " Dip. Tech." A student apprentice aims, that is, to become a fully qualified professional engineer. The issue of this report follows up that of a similar document entitled the " Training of Graduates," in January, 1957, which related to practical training following upon the successful completion of a degree course at a university. As, however, the present report relates to a course in which theoretical studies are closely integrated with practical training it enters more deeply than did the former report into the nature of the college syllabus. Perhaps as a corollary it is less definite in its recommendations about the nature of the works training though the general idea expressed is the same, that the student should first obtain basic and general experience of how things are made and what materials are used, and gradually work through to " directed objective training " in the last eighteen months of the course, meaning specialisation upon the field of endeavour which the student has chosen.

The document arouses in the mind much the same speculations that were aroused by the previous report. It is obvious that as budding professional engineers need to spend longer periods over their academic training if they are to reach adequate standards then, unless the total training period is to become intolerably long, the practical part of the training must be condensed. Our fathers spent four or five years going through the works ; our sons must acquire this practical experience in two years or even less. This change has necessarily led to a demand for more consciously planned works training ; and conscious planning, very naturally, has led engineers interested in education to ask pertinently, amongst other questions, whether some of the works training, traditionally based upon the idea that an engineer must acquire a degree of handicraft skill, is really as essential as it has been held to be. Certainly, the trend is well away from that conception. The modern aim, to quote from the document before us, is " not to make the trainee a proficient craftsman, but to give him a working knowledge of the tools, materials and processes commonly employed in engineering." Yet the time to be spent on acquiring this " basic " experience, at nine to twelve months, and the suggestion that some at least of it should be acquired in an apprentices' training workshop suggest that the actual training given often accords more closely with tradition than with the stated aim ! The question does seriously need asking, in these days, to what degree do professional engineers, other than those intending to specialise on production, really need to acquire any degree at all of handicraft skill ? The major factor in works training is to acquire an understanding of the whole organisation and working of an industrial concern, of the psychology of those who work there, and of the kinds of engineering limitations there are upon what can and cannot be done there. Of course, it may be that only through the actual acquirement of some handicraft skill can a true appreciation of a works atmosphere be obtained. That is a question open to debate. But the chief future contribution of a professional engineer will lie in the application of his brains to engineering problems and it is the limitations imposed by machines rather than by handicraft skills which influence what engineers can or cannot do. Another question that needs still to be decided is as to how far specialisation should be pushed in the final months of the course. But that, very possibly, is something which the student to a large extent decides for himself through his interests becoming increasingly concentrated towards a particular field.

The report also arouses discussion of certain ancillary questions. As the Dip. Tech. courses develop and as the numbers of engineering undergraduates at universities increase, as they are planned to increase, how is room going to be found for the larger number of trainees coming forward ? The larger firms able to offer a sufficiently varied industrial experience clearly feel that a limit is being approached. Some of them, we understand, have already up to 25 per cent of apprentices amongst those employed in the shops. Is it possible to contemplate pushing that figure even higher ? The alternative is to organise groups of firms, each specialised in product, to agree to provide for students, jointly, the necessary wide experience. One such group scheme is operating in Scotland. But we rather wonder how satisfactory such schemes are. For where do the students' roots go down ? An advantage a university graduate has over the " sandwich " man is that he spends two or more years continuously in a works. He comes thereby to associate himself intimately with the works and to acquire a special loyalty towards and understanding of it. No such loyalty can possibly be acquired by a sandwich student if each of his periods in the works is spent with a different firm. We hold the Institution wise in such circumstances to advise that one of these firms should be his sponsor throughout, even if it cannot provide the whole training itself. Certainly no technical college can effectively take the place of an industrial firm as the sponsor of industrial training. For, hard as technical colleges will certainly try, when a student has no other sponsor, to arrange suitable industrial training, they must inevitably accept what they can get ; and what they can get may often fall far short of the desirable. One further implication can be drawn from the report. As a route for reaching full professional status in electrical engineering the National Certificate courses seem likely to dwindle in importance. The Higher National Certificate already gives exemption only from Parts I and II of the Institution's examinations. A year of part-time study is necessary before Part III of that

examination can be attempted, more probably two years. There is no intention whatever of closing this route to membership of the Institution. But it is clearly felt that youngsters appearing sufficiently well endowed with brains to become professional engineers will be transferred in future from the early stages of National Certificate courses to Dip. Tech. courses. The National Certificate route will remain open only for those who develop late and who have the hardihood to withstand six or seven years' hard grind of evening study after a full day's work, two or more nights per week. In this matter of studying consciously how works training should be carried out the Institution of Electrical Engineers has been leading the field. It will be interesting in due course to see what conclusions other Institutions draw.

WEAR AND TEAR

We reproduce in this issue extracts from the second part of Mr. Johnson's discourse to the Institute of Road Transport Engineers. We have found his words worthy of much study and deliberation, after which we find ourselves on some points at issue with their author ; for instance, so long as road transport vehicles retain the unusual ability to amortise their initial cost in a reasonably short time, we believe operators would be well advised to continue to pay the price, high as it may be, of a pressure reservoir with a safe life exceeding that of the vehicle—aircraft engineers, we feel sure, would be the first to anathematise the burden of inspecting and the danger of testing the more " efficient " vessel. But we have been, and we expect our readers will agree, impressed by the restraint with which Mr. Johnson refrains from blaming the engineers or the manufacturers for the many problems that have confronted him. It is hardly reasonable that the efficiency, far less the safety, of a machine should depend on the frequent performance of a laborious check on a dozen settings with a special tool—and while there has now been evolved a valve cap which declares a deficiency in tyre pressure to a visual or tactile inspection, it increases the work involved in inflation. It is clearly undesirable that a body should have to be designed to withstand, not only the manual and mechanical on- and off-loading of freight, but also the distortion of its supporting chassis—but since Mr. Johnson's first address we have seen a major manufacturer regress from torque tube drive to Hotchkiss drive professedly in order to allow the chassis to flex and ease the suspension problems !

Our view it is, however, that in one important direction Mr. Johnson is too tolerant and that is in stating the need for the introduction and acceptance of standards. For we are well aware of the menace existing in the facile following of unsatisfactory standards such as causes the little " Sprite " to have headlights the same size as those of a great " Princess." The latest additions to the Handbook of Standards issued by the Society of Motor Manufacturers and Traders seemed in places to indicate more enlightened approach to standards; at least we noticed that a tolerance bracket was stated for the superficial density of leathercloths, and the acceptable performance, if not the life between inspections, of an earth return throttle travel sensing switch is laid down. But the " standards " for tyres, for example, are little more than tables of loads and inflation pressures and, as they may be interpreted as meaning that tyres will have a satisfactory life under the specified conditions, are liable to encourage operators to associate load-carrying capacity with size, thus further hindering the struggle of designers to reduce the tyre size needed for any load. This is the more distressing because the great justification for standardising a rated load, that one can then require the manufacturer to measure and guarantee the static deflection and the rate of change of side force with camber and slip angles, is flouted. Nor can one see that it would be difficult to satisfy Mr. Johnson's very reasonable desire that tyres nominally the same size should have the same rolling radius ; if the S.M.M.T. were to define tolerance brackets on, say, circumference, manufacturers would find themselves able to ask a higher price for products within the closest bracket and would be able to assess quantitatively the demand for products of precision.

It is the absence of standards of measurement that alarms one most in attempting to assess the worth of this mass of specifications. There are no standards for the conduct of tests on chassis dynamometer or on the road ; and the need for indisputable measurements of vehicle performance, if it is not blatantly obvious, can be inferred when we find the pronouncements of the Road Research Laboratory dependent on a mere surmise as to the trend of performance of typical cars over a ten-year period. Even that very sensitive test, the endurance run on pavé, is not prescribed ; had it been, the Motor Industry Research Association would have been spared much criticism. Measurements of fuel consumption and of the effort demanded of a driver are at present almost worthless for lack of a specified procedure. These omissions are the less forgivable when we contemplate the advances such standards would initiate. Granted tests yielding a significant measure of each aspect of vehicle performance, the Society could then define grades of overall performance. If experience showed a significant correlation between, say, mileage between accidents and performance, the insurers would doubtless welcome a means of satisfying themselves that each vehicle was suited to the job for which it was intended. And, most valuable of all, the persistent, even strong, belief, which it is frightening to find influencing ministerial deliberations, that one single " go—no go " standard of performance can be anything but an expensive incubus upon development, would wither and expire.

LABOUR RELATIONS

The Central Office of Information is called upon to perform many and varied tasks concerned with the dissemination of what may be termed " Government news." It prepares and circulates all kinds of publicity material, a great deal of which goes overseas. In recent years, the Central Office has undertaken the preparation of a series of " reference pamphlets," the majority of which have expounded various aspects of life in the United Kingdom and in some countries of the Commonwealth. The latest pamphlet in this series, which has just been published by H.M. Stationery Office, is entitled *Labour Relations and Working Conditions in Britain*. The pamphlet is designed primarily for overseas readers, but there will no doubt be many people in this country who will find its contents informative as well as interesting. For although millions of words have been spoken and written in the last decade on the subject of industrial relations, it is not always easy to form a clear picture of the organisations and procedures concerned with them. The pamphlet before us describes the general structure of employers organisations and trade unions and, with the aid of a couple of " genealogical trees," clarifies the agreed procedures of negotiation—

procedures that frequently appear to be tortuous when disputes arise. Throughout the pamphlet, there is emphasis on the fact, that " the structure of industrial relations in Britain is established mainly on a voluntary basis." That is a matter on which people of all shades of opinion in industry often express their satisfaction. The Government of the day can, and does, advise and mediate in times of industrial dispute, but no Government of recent times has sought to achieve good industrial relations by legislation. It would not work !

Nevertheless, there has lately been rather more than a shadow of doubt about the efficacy of this country's industrial relations systems. That doubt tends to grow when, as stated in the Ministry of Labour's annual report published this week, 8,142,000 working days were lost last year through industrial disputes. It was the worst year for strikes since 1926. That there is room for improvement is well realised. Certainly, the establishment of good working conditions is assisted by the organisations of employers and workpeople and by the accepted arrangements for negotiating and settling disputes. But, as the pamphlet points out, " this institutional framework cannot by itself create in particular enterprises satisfaction with work and working conditions, mutual trust and co-operation of management and workers, or that sense of shared effort and achievement known as team spirit." Such an achievement still depends on the building up of good human relations between individuals and groups within the organisation. Once upon a time it would have been described as complete understanding between master and man. We are glad to note that the author of this reference pamphlet stresses the importance of the building up of complete understanding between employers and employed. For, even though this kind of sentiment may by some be dubbed as platitudinous in these days, neither private nor nationalised industry can hope to function successfully without it.

THE RESERVE FLEET

A week or two ago, in these columns, we referred to the announcement by the First Lord of the Admiralty that six British aircraft carriers are to be scrapped or sold. Mr. Allen, Parliamentary Secretary to the Admiralty, has now informed the Commons that five cruisers, seven destroyers and several frigates, minesweepers and other small craft are also to be scrapped or otherwise disposed of. Apart from eighteen of the thirty-one fast patrol boats on the disposal list every one of the vessels earmarked for scrapping or selling is of pre-war or wartime construction and could not have been made capable of operating with the Fleet without extensive modernisation and reconstruction. Thus there seems to be no justification for the surprise which is evident from questions in both Houses at this slaughter of ships. Parliament, in approving the Government's defence proposals, approved plans—which are to be in full operation in 1960—for an Active Fleet strength of only four aircraft carriers and three cruisers—with some destroyers, frigates and submarines.

It is thus impossible to argue that these old ships are required to maintain a Fleet of this size in commission. Within the next two years, the carrier " Hermes " and the three " Tiger " class cruisers, will have been completed, which means that—apart from any further scrappings which may be decided on in the future—the Royal Navy will be left with seven front line carriers, 17 cruisers and some 56 destroyers. The real point is, of course, that the Royal Navy is not making " an effective contribution to the navies of the Western Alliance," it is to provide two carriers and two cruisers—with a few destroyers, frigates and submarines—for the whole of the Atlantic and Mediterranean area, intended primarily as a contribution towards the anti-submarine role. Whether it is desirable to employ 43,000-ton carriers—such as the " Eagle " and " Ark Royal "—in the anti-submarine role is open to question. But if the British Government really believes that the Allied navies will have an important part to play in global war, these four large ships can scarcely be regarded as an effective contribution by a first-class naval power. The same may be said of our current naval building programme. Whereas Congress has approved £535 million for the construction of ships during the present year now ending, Britain is content with completing one carrier and three cruisers—all laid down during the war, between fourteen and seventeen years ago. Nor would it be possible to provide for our peace-time and limited war responsibilities with two carriers and one cruiser, to cover the vast area east of Suez, were it not for help from the navies of the Commonwealth.

In the light of our present defence policy, however, with priority given to "the deterrent" and the need for every ship required for fighting to be up to date in weapons and equipment and to be ready for sea at short notice, the Admiralty can in no way be blamed for reducing the Reserve Fleet to the minimum required, as approved by Parliament. As a seafaring nation, indeed, we might well be more concerned with the information recently given to the House by the Civil Lord of the Admiralty. Eighteen licences, totalling approximately 200,000 gross tons, for the building of new merchant ships in United Kingdom shipyards were cancelled during the first half of this year. The total value of these cancellations amounts to about £25,000,000. Well may be it said that while the British shipbuilding industry is reasonably cheerful as regards building orders, it remains in a state of " apprehensive prosperity."

The Engineer— 100 Years Ago (JULY 23, 1858)

" AGRICULTURAL STEAM MACHINERY "

" We have by no means reached the ultimate point attainable in our methods of tillage. The possession of the new agent now beginning to be employed will result, doubtless, in the application of methods as little related to the old as is a modern power-loom factory to the old hand-loom weaver's shop.

" We have a shrewd suspicion that the employment of steam-power will be somehow called to relieve us of the infection of our streams by applying the sewage matter to the land, and thus helping in the multiplication of production. The country is ringing just now with the filthy condition of the Thames, and the immediate need of remedial means there. But the evil is almost an universal one, in a greater or less degree. Wherever men are congregated in numbers, the nuisance of refuse matter, which would be invaluable to the farmer, is felt. No means known seem sufficient for the universal conversion of this growing curse—growing in many districts to a most alarming degree—into the source of the teeming increase in agricultural produce it is capable of becoming. There seems to be a field here for the giant, steam. This surely is the modern Hercules that is to cleanse this modern Augæan stable, and to transmute the causes of tainted airs and poisoned streams into multipliers of food produce.

" The multiplication of produce will increase the want already felt for the aid of machinery in gathering and bringing to market the produce of our fields. . . . We must possess the means of ' making hay whilst the sun shines,' however seldom he may shine, and however large the quantity of hay. Ingenuity will find here a profitable field of invention, which, there is no doubt, will in due time be occupied. These are some of the facts that invest the machine yard of the Royal Agricultural Society's show with so much importance."

North of Scotland Hydro-Electric Schemes

No. IX: THE BREADALBANE SCHEME—PART III *

From the substantial amount of tunnelling work, and the various hydraulic control points throughout the Breadalbane scheme, certain examples typical of the scheme as a whole are described here. The tunnelling included a novel system of shaft raising at St. Fillans, and a continuous shutter, shown on the right, for concreting the Lochay tunnel. The kind of discharge regulator installed at Lednock, Lubreoch and Giorra dams is described, and the syphon spillways at Lubreoch dam, which have a non-mechanical depriming device, are explained.

THE Breadalbane scheme as a whole is typical of Highland hydro-electric works in the extent of the tunnelling needed to build it. Apart from the main tunnels connecting the reservoirs with the principal power stations, there are extensive aqueducts bringing in the flow from the "indirect" catchment areas; these aqueducts are partly formed by reinforced concrete pipes, but a great deal of tunnelling is involved in their construction. The tunnels of the scheme are in the region of 60 miles in length, all told, all of which is rock tunnelling.

In the St. Fillans section, the tunnel from Lednock reservoir to St. Fillans power station is nearly 18,000ft in length, and has an equivalent diameter of 9ft 6in for most of its length. The main tunnel of the lower stage, Dalchonzie tunnel, is over 16,000ft in length and has an equivalent diameter of 11ft 6in. The collecting tunnels are often unlined, or with only the invert lined with concrete. Their base widths vary from about 7ft 6in to 10ft, and they generally collect the flows from various streams through pipe aqueducts. In the upper stage, the collecting tunnels total 58,000ft in length and the surface aqueducts 24,600ft.

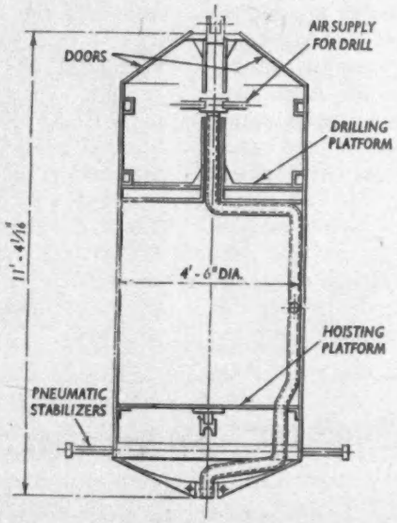
The tunnels in the Killin and Lawers sections are generally similar. The main tunnel of the upper stage of the Killin section from Giorra reservoir to Cashlie power station is over 13,000ft long, and 8ft 6in in equivalent diameter. The lower stage tunnel, from Stronuich to Lochay, is 25,000ft in length, and its diameter is 13ft 5in.

The underground power station at St. Fillans has involved construction of a vertical shaft 590ft deep, with the surge shaft above it, near the downstream end of the main tunnel; from the foot of the shaft a pressure tunnel 2392ft in length, the last 648ft of which is steel lined, leads to the power station. Above the other power stations of the scheme the layout is conventional with a surge shaft and steel penstock at the end of each of the main tunnels. At Lochay, for instance, the last 408ft of the tunnel is steel lined, at the portal there is a valve house, and then the steel pipeline. The pipeline is of riveted construction, 1670ft long, and is 10ft, reducing to 9ft, in diameter; it is held at three anchor blocks with expansion joints in each length, the last length, close to the power station, being buried.

Apart from the main penstocks, there is also an inverted syphon in the collecting system of the Killin section. It connects the collecting system of an extensive catchment on the south side of the River Lochay with the system on the north side, which feeds into Lubreoch reservoir. The crossing of the Lochay valley is made with a steel pipeline 6ft 6in in diameter, and about a mile in length. The collecting system of the Killin section includes twenty-five major stream intakes, 17 miles of tunnels and 10 miles of concrete pipe aqueduct. These works are generally proportioned to carry about five times the mean flow of the streams which are diverted.

ADVANCES IN TUNNELLING TECHNIQUES

In the early stages of the North of Scotland Hydro-Electric Board's constructional programme, great emphasis was laid on training tunnelling crews and improving techniques of rock tunnelling. The "Swedish" methods



Cage used to excavate pilot shaft at St. Fillans

of drilling were introduced, and new methods of tunnel lining were tried out, all of which have been commented upon in earlier articles. The stage has now been reached when such tunnelling works can be carried out extraordinarily quickly, and there is not a little competition in introducing quicker and cheaper methods. The tunnelling for the Breadalbane scheme saw all these developments at their height, and at one stage a world record was claimed for the speed of driving one of the tunnels. This was in 1955, when 557ft was driven in seven days (October 19 to 26) in one of the collecting tunnels of the St. Fillans section. The rock through which this pace was kept up was a grit formation, with mica intrusions, known as Ben Ledi grit. The tunnel has a bed width of 8ft 6in; during the seven days, three teams of thirteen men worked eight-hour shifts, and ninety cycles of work were completed, the average "pull" being 6ft 4in.

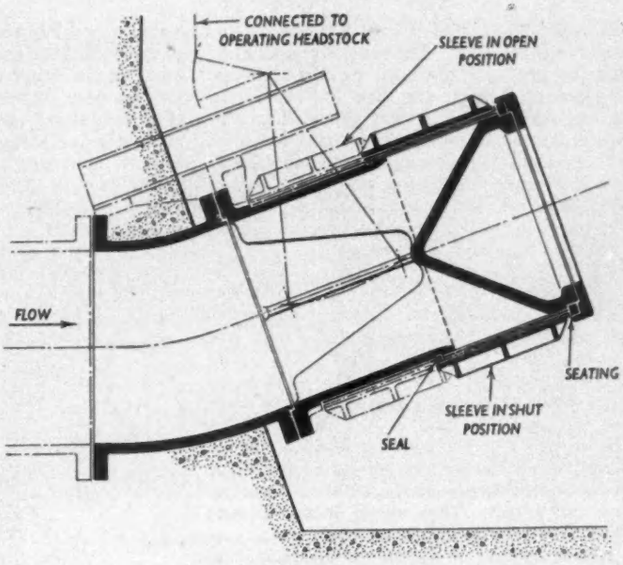
Construction of the vertical shaft connecting the low- and high-pressure sections of the main tunnel to St. Fillans power station was another job which was carried out in an unusual manner. The shaft is almost 600ft deep; the surge shaft rises above it to ground level. The first stage in its construction was to drill a hole 6in in diameter from the upper level for the full depth of the shaft, so that it broke out into the high-pressure tunnel; this hole was, in fact, drilled within an accuracy of 2ft. Headgear was then erected on the floor of the surge shaft, and a cable was threaded through the hole. Drilling and charging the face of a pilot shaft then proceeded from the lower level, using a cage suspended from the cable. The cage was lowered and the rope retracted prior to blasting each charge. It was then raised again to the face, and held by stabilising arms. Doors in the upper compartment of the cage were then opened to allow the men in it to work at the face. The cage was equipped with a compressed air main and telephone and an emergency air supply. The pilot shaft was excavated at an average rate of 64ft per week, the maximum weekly rate achieved being 138ft; it was about 6ft in diameter. Enlargement to the full section proceeded from the top, a platform with two men being lowered from the same headgear, to the working face, and withdrawn each time blasting was carried out. The accompanying drawing shows the cage used to construct the pilot shaft. This drawing is taken from the paper "Shaft Raising in the Scottish Highlands," by Mr. R. S. Henderson,† in which a full description of the construction of the St. Fillans shaft is given. The contractor who carried out the tunnelling works on the St. Fillans section was the Mitchell Construction Company, Ltd. This firm is also building the Dochart–Lochay system of collecting aqueducts in the Killin section.

The main tunnel serving Lochay power station is noteworthy in that it has been

* No. VIII, The Garry and Moriston Schemes, appeared October 5–November 9, 1956.

† *Journal I.C.E.*, Vol. 6, April 1957.

driven from only two faces over a distance of about 4½ miles. There is always an element of unexpected hazard in tunnelling works, a characteristic which showed itself in the Lochay tunnel. In the drive in the downstream direction, a major fault which was not expected was encountered without warning about 7000ft from the portal. The fault was water-bearing, inflows of 50,000 gallons per hour being experienced, which flooded the tunnel for 5000ft. After pumping out, a diversion was made, crossing the fault at right angles and using cast iron segmental lining.



Sleeve valve discharge regulator

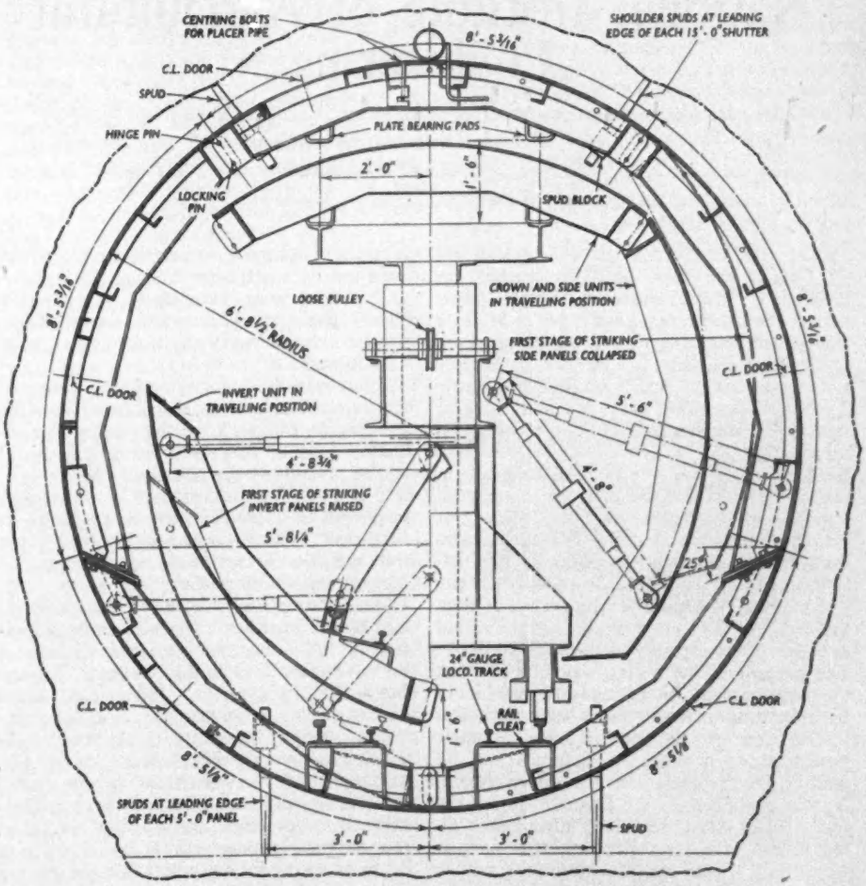
Perhaps the most interesting feature of this tunnel is the continuous shutter which is now in use to construct the lining. The shutter is circular, and the entire concrete lining is placed in one operation. Its total length is 240ft made up from sixteen sections, each one 15ft long. The accompanying illustrations show the shutter and part of the rail-mounted traveller which successively moves the last shutter section to a new position at the front.

Concreting is carried out without stop-end shutters, and is continuous throughout the week. A sloping joint, formed by the angle of repose of the newly placed concrete, separates each week's wor' Up to now the maximum weekly rate of concreting has been 1000ft and the average 550ft.

Dry batches of concrete—each of half a cubic yard—are brought into the tunnel from the unlined end in side tipping wagons. The wagons discharge into the boot of a conveyor which feeds a half-cubic-yard Koehring double-drum mixer. The mixed concrete is then passed into a pneumatic placer, the capacity of which matches the output of the double-drum machine. This train of plant is, of course, rail mounted.

The traveller is hydraulically operated by a hand pump. It has a beam cantilevered in front of it, which is used to pick up the invert shutter. The sequence of operations in striking and refixing a 15ft section of shutter (each 15ft section consists of three fabricated 5ft lengths bolted together) is as follows. The traveller is positioned on the section, and its top beam is raised, hydraulically, to support the arch and side shutter unit. When it is in position, this shutter is unbolted from the invert shutter and struck by withdrawing it on each side, by the turnbuckles, so that it folds in, but with the arch still in position until the beam of the traveller is lowered. The traveller is then moved backwards out of the shutter on to a short length of rail laid temporarily. Its cantilever then picks up the invert shutter, after the latter has been folded in by operating the turnbuckles. The shutter can then be moved through the remaining shutters which are still in position. So two short lengths of rail are placed in the position from which the invert shutter has just been removed, and the traveller is then moved forward to the other end of the assembly. The narrow gauge rails shown on the drawing are for the locomotive which hauls the traveller. The invert shutter is first placed in position, by lowering and "unfolding" it. It is bolted on to the one already in position and levelled by adjusting the "spuds." The arch and side shutter is then similarly positioned (note that there are two further spuds in the arch) and bolted to the invert. Slight errors in alignment can be taken up by bolting one side of this joint more tightly, and by adjusting the spuds differentially; but the accuracy of fabrication of the shutter is high, and experience so far is that it maintains its alignment very well. For curves, however, special shutters can be introduced. The shutter depends for economy on repetitive usage, the Lochay shutters having about a hundred uses which is, we understand, close to the economic minimum.

Trial assembly of shutter element at maker's works. The traveller is shown from the back



Details of continuous shutter and traveller for the Lochay tunnel

The contractor for the Lochay tunnel is Edmund Nuttall, Sons and Co. (London), Ltd., and the continuous shutter was made to that firm's design by Birwelco, Ltd.

One other tunnelling contractor is carrying out extensive works on the Killin section. The Cementation Company, Ltd., is constructing the Cashlie tunnel and the system of collecting aqueducts associated with it. This work is progressing steadily and the main tunnel has been driven and about a quarter of its length lined with concrete.

Here the contractor uses a stop-ended shutter 120ft in length, which is moved a minimum of four times a week to maintain schedule.

Gates, Valves and Side-Stream Intakes

Generally, the intake works and hydraulic control gear of the various parts of the Breadalbane scheme follow fairly well-established practice. At the head-pond dam at Stronuich, for example, there is a Borland fish lift, a compensation-water power station, a long spillweir, and an intake to the main tunnel. This intake is positioned alongside the fish channel, and is dimensioned so that the flow through the fine screens does not exceed a velocity of about 1ft per second, and fish are not swept against them. The intake itself is controlled by a single gate—a simplification over the more usual installation of a control gate and a guard gate. This practice is repeated at Lubreoch dam.

The intakes of the collecting aqueducts are also similar in many respects to those of schemes we have already described. Taking for example the St. Fillans aqueducts, the intakes from many of the streams are built in the crest of a weir, so that the intake is self-cleaning in time of flood. Sand and silt is settled out of the diverted flow. In those intakes which feed into the main tunnel to the power station, precautions must also be taken to see that air is not entrained in the diverted water. One such diversion flows into the surge shaft. Here and at another intake shaft on the main tunnel a sleeve has been built within the shaft, leaving a small annular gap so that the flow is induced to form a sheet down the walls of the shaft. At the other shafts referred to a vortex chamber has been built above the main tunnel, connected to the tunnel by a throat, and with an air pipe leading up from it in some cases. This chamber allows air to escape before the flow passes into the tunnel. Any entrained air which does reach the main tunnel, however, can escape at the surge shaft. The tunnel has a long tapering bellmouth at this point, so that its area is substantially increased, the velocity of flow thus being reduced sufficiently to allow air bubbles to rise to the surface.

An innovation in recent Scottish practice in reservoir construction is the replacement, at the three dams of Lednock, Lubreoch and Giorra, of the usual needle valve and disperser at the outlet of the scour culvert by a discharge regulator. This device is illustrated diagrammatically on page 125. It comprises an inlet pipe section, a body piece, a sliding sleeve and an operating mechanism. The pipe section and body are of "Meehanite" cast iron or cast steel, the body being cylindrical in shape with an integrally-cast inverted conical head connected to it by a number of internal radial stiffening ribs. The body and ribs are fitted externally with faced strip guides, machined to suit the bore of the sliding sleeve. This component is of fabricated construction, having a "Colclad" steel-plate tubular portion with external rolled steel ribs. Fitted to the downstream end of the sleeve, is a stainless steel face ring which seats on a rubber face ring housed in the outlet end of the body and is retained therein by a steel junk ring. A seal is also provided between the body and sleeve to prevent leakage between these parts. The operating mechanism, which imparts axial movement to the sleeve, consists of a bell crank connecting the hand-operated headstock screw with the sleeve.

Since the reaction of the water jet on the sleeve seat and the total skin friction are negligible, and the sleeve is virtually balanced, the forces to be overcome by the actuating gear are only the frictions due to the small resistance of the body/sleeve seal and to the weight of the sleeve. The conically expanding hollow jet is in itself an excellent energy dissipator. Under the low or moderate heads, for which it is best suited, the valve will continue to work satisfactorily even in the event of it becoming totally submerged. Of the three valves on the Breadalbane dams two are 72in diameter for fully unbalanced heads of 39ft and 85ft, and one is 60in diameter for a head of 105ft.

Syphon Spillways at Lubreoch Dam

Flood discharge at Lubreoch dam is achieved by an overfall spillway and two syphon spillways. The former is 156ft long and its crest level is 1127ft O.D.; its maximum discharge capacity will be 5850 cusecs, under a head of 4·35ft. This discharge will fall into a stilling pool, where the depth of standing water will be 8ft 9in. The two syphon spillways each have a capacity of 1200 cusecs. They are of special interest because of the depriming arrangement.

Each syphon is 6ft 6in in diameter, and has a drowned intake which projects from the upstream face of the dam. The outlets are at 1073·5 O.D. on the downstream side; each one is fitted with a disperser. The accompanying diagram shows the depriming arrangement, which utilises a small auxiliary syphon and a differential water level chamber (*B* and *C* respectively in the diagram).

When the syphon is discharging, the level in the differential water level chamber *C* is maintained sufficiently high to cover the mouth of the standing water column tube *E* until the falling reservoir level causes the auxiliary syphon *B* to deprime. The chamber is then drained rapidly through the drain *D*, giving a positive and continuous uncovering of the mouth of the tube *E*. Most of the water in the water column then passes over into the main syphon tube *F* and the supply of air is sufficient to deprime the main syphon positively and almost instantaneously, giving smooth depriming conditions.

The priming cycle begins after the primed auxiliary syphon builds up sufficient head in the differential level chamber to cover the mouth of the air inlet. The diagram also shows the auxiliary syphon's connection to the reservoir, which is also at a depth sufficient to damp out major wave action.

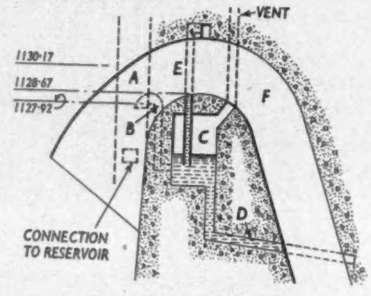


Diagram of syphon spillway at Lubreoch dam, showing depriming arrangement

Model tests have shown that the syphons should prime with reservoir water levels 6in above the syphon crest level. They are designed to break 2ft below that level. They are set with one syphon 6in higher than the other, so design heights of priming and breaking, above spillway crest level, are respectively 2ft 2in and 2in, and 2ft 8in and 8in.

(To be continued)

National Institute of Agricultural Engineering

Recently the National Institute of Agricultural Engineering held two "open days" which attracted numerous visitors from all parts of this country and from overseas. There was opportunity to examine the nature and method of the testing, research and development work now in progress.

THE National Institute of Agricultural Engineering has been established in permanent headquarters at Wrest Park, Silsoe, Bedfordshire, since 1947. It is a state-aided body, the administration of which is the responsibility of the British Society for Research in Agricultural Engineering. The work at Wrest Park is carried out in nine main departments, under the general direction of Mr. W. H. Cashmore. Briefly, the functions of the Institute are to engage in research and development in the interests of agricultural mechanisation, to carry out impartial tests on tractors and agricultural machinery, and to form a centre for information on all aspects of agricultural engineering.

The demand on the testing service is high and has been for some time, in fact, somewhat in excess of the capacity of the staff available. The purpose of the testing service is to assist the development of agricultural machinery by providing manufacturers with technical information on the performance of their prototype or production machines and by making recommendations for improvement. As was explained by the Director during the recent open days, frequently discussions on the results of a test offer opportunities for passing on to the manufacturer the findings of the research departments. In general, the Institute's testing work provides background information which helps to keep the research and development programme on practical lines. The test reports which are published furnish unbiased accounts of the performance of machines.

There were several static exhibits, prepared for the open days, to demonstrate some of the procedures followed by the testing department. One of them showed a scheme for testing fertiliser distributors. Before the test is started the distributor is thoroughly inspected and careful note is made of its condition. The fertiliser samples used in the tests are also checked, such measurements as bulk density and particle size being made under a procedure which has been standardised by the Institute. The stationary calibration of full-width distributors is carried out on a calibration bridge devised by the N.I.A.E. Spinning-disc and related kinds of distributor are operated in a collecting "box" designed specially for the task. Full-width machines are calibrated at 3 or 4 m.p.h. and spinning-disc machines at the speed indicated by the manufacturer. Each calibration run represents about 500ft of travel (approximately one-tenth of an acre for a 9ft machine). All the initial calibrations are done with the fertiliser hopper starting from

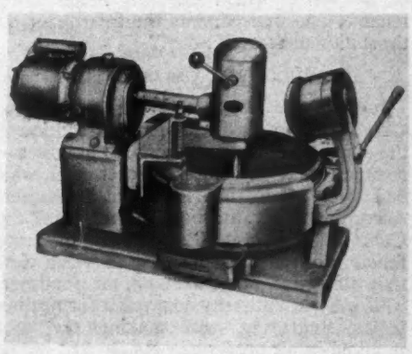
full, but in order to investigate the influence of fertiliser "head" on delivery rate, one of the intermediate calibration runs is repeated with the hopper half-full and then a quarter full. The evenness of spread at right angles to the direction of travel is determined, the full spread being, in effect, divided into 3in strips and the weight of fertiliser on each measured. With full-width distributors, this work is done on the calibration bridge, using 3in wide interlocking trays, but spinning-disc machines are driven over a different set of 3in trays made from polythene film. Collecting trays, also 3in wide, are used for determining longitudinal evenness. For this part of the test, the distributor is towed over the trays which are placed on a level surface so that vibration is reduced to the minimum. It should be added that the test includes a minimum of twenty hours' actual work on a farm. During the test records are kept of any breakages or distortions of the machine, and when the test is completed another examination of the machine is made to determine whether any excess wear has occurred.

Experimental ditch cleaning machine at work

Research and Development Work

The Institute's research and development programme is naturally a varied one, its principal objects being to provide data required by design engineers and to give agricultural specialists information on which to base new techniques. Research cannot easily be separated from development as the building of an advanced experimental machine is often a logical sequence to a research project. But the value of the work, as a whole, may be assessed by the fact that a number of machines now in production owe much to the Institute's research and development activities. One machine in this category is a laboratory soil grinder which has resulted from work undertaken by the Institute's mechanical engineering department. Six years ago, the Institute agreed to investigate the possibility of developing a machine for grinding soil samples prior to chemical analysis. The request for this investigation came from the National Agricultural Advisory Service whose chemists were, at the time, dealing with about 250,000 samples a year at twelve centres. The conventional method of preparation by pounding the soil by pestle and mortar and then sieving gives generally satisfactory results, but it is, of course, arduous and time-consuming work. The investigation by the Institute, therefore, had two objectives, namely, to speed up the production of samples and to reduce the physical effort required. In devising a suitable machine, it was necessary to keep in mind the desirability of eliminating metal-to-metal contacts within the grinding mechanism itself, so that noise was reduced to a minimum. Moreover, metals such as zinc and copper were not suitable for grinding surfaces as routine work often involves analysis for such trace elements in soils.

A paper* by G. R. Chalmers and R. H. Marsden recalls how the first idea to be tried at the Institute consisted of a stationary mortar with a rubber-bonded base having a 2mm sieve fitted in the form of an annulus around its periphery and two (or more) pestles with flat rubber-faced bases mounted on a rotating crosshead, but free to rotate about their own axes. The notion underlying this arrangement was that the centrifugal action of the pestles would cause the soil to be thrown out to the periphery of the mortar, where particles of 2mm size and under would pass through the sieve into a tray below, while the remainder of the sample could be brought back towards the centre of the mortar and again into the path of the pestles by scrapers also mounted on the crosshead. It was hoped that the provision of a large grinding area would give a high rate of grinding. A machine on these lines was built in 1953, but it gave only indifferent results. The components of the machine were then used in a series of experiments to try the effect of different arrangements of pestles, mortars and scrapers. Ultimately, a "lash-up" was evolved, which, although clumsy to operate, worked satisfactorily. The experience gained with this machine enabled design data to be drawn up for the grinder which is now being produced commercially by Measuring and Scientific Equipment, Ltd., Spenser Street, London, S.W.1. The machine, which is illustrated herewith,



Laboratory soil grinder

consists of an electrically driven rubber-faced cast iron mortar and a stationary pestle. The mortar has a detachable grinding base, which may be either of steel or rubber-faced steel, and incorporates thirty-six circular sieves with 2mm diameter holes. The pestle, which has a detachable steel or rubber-faced pestle plate, is arranged for carrying interchangeable weights to enable the pressure on the sample to be varied to suit different kinds of soil. A stationary scraper, attached to the cover of the mortar, ensures that the soil is constantly fed to the pestle during grinding, and the equipment includes a removable tray for collecting the sample. The performance of the machine during the prototype stage has shown that the time taken to grind a 1lb sample varies from one minute for a loamy sand to five to six minutes for a clay loam. It is claimed that an output of 150 samples a day can be expected.

Another project on which the soil and mechanical engineering departments have been engaged for some time is concerned with the development of an experimental ditch cleaning machine. The machine, which is shown in its present form in the accompanying illustration, has been found satisfactory for cleaning farm and forest ditches up to 4ft deep. It is built on to the offside of a "Farmall M" tractor fitted with a reduction gearbox (ratio 3·16 : 1) and consists of a power-driven rotor made from two aluminium alloy cones riveted base to base to a high-carbon steel rim. The rotor is mounted on a hydraulically-lifted parallel linkage in such a way that it is tilted at 11 deg. towards the tractor at the top, and is set obliquely at an angle of 36 deg. to the centre line of the ditch, the leading edge cutting along the near-side bank. There are eight cutting blades for shaping the ditch profile and eight beaters for ejecting and scattering the spoil ; they are fitted to the rim of the rotor in alternate order, being attached by shear bolts to allow them to fold back so that damage to blades and beaters is avoided if immovable obstructions are encountered. The drive to the rotor is taken from a modified tractor belt pulley through gearboxes, pulleys and vee-belts; the normal speed of the rotor is approximately 120 r.p.m. at full throttle. Two hydraulic cylinders control the position of the rotor ; one operates when the rotor is in its working range and the other raises the rotor into the transport position. The depth of cut is controlled by an adjustable gauge wheel, fitted to a leaf-spring attached to the rotor spindle, which runs in the ditch ahead of the rotor. A hydraulic accumulator incorporated in the hydraulic lift circuit provides, in effect, a spring mounting and permits an adjustable proportion of the weight of the rotor assembly to be carried on the tractor.

In the Institute's mechanical engineering department, the testing of components of hydrostatic transmission is now undertaken as a matter of routine. As part of the department's research programme an investigation is in progress of the factors affecting the performance of a hydrostatic wheel motor (see THE ENGINEER, April 27, 1956) with particular reference to the performance of face valves.

The horticultural department is doing a variety of work concerned with spraying processes and equipment. The development work, demonstrated on the open days, includes an automatic orchard sprayer for investigating low pressure air blast nozzle spraying. This work has involved the development of corrosion-resistant pumps, tanks and flow meters. The sprayer which has been devised and built at the Institute is equipped with a glass fibre tank to contain the spraying liquid. In the grain department, one of the researches in progress is associated with the performance of auger conveyors. The work on oscillating grain conveyors now includes study of the effect of inclined conveyors.

* *Journal of Agricultural Engineering Research*, No. 3, 1957.

Rudolph Ackermann, 1764-1834

By A. K. BRUCE

OUTSTANDING among works of construction and reconstruction completed in the Strand, London, is the restoration of the Church of St. Clement Danes (at the head of Essex Street, wherein the offices of THE ENGINEER lie), reduced by bombs and fire to a roofless ruin. Rehabilitation of the building will deepen the associations lying thick in and around it, associations now to be made still richer by its dedication as the Guild Church of the Royal Air Force. St. Clement Danes possesses particular interest for engineers as being the burial place of Rudolph Ackermann, who, in addition to playing a notable part in promoting the use of gas for illumination and heating, pioneered the development of the pivoted stub axle (with articulated control rod) for vehicle steering. Ackermann was born on April 20, 1764, at Stolberg, in Saxony, the son of a coach builder and harness maker. He served his apprenticeship as a coach builder and appears to have made his way to Great Britain some years before the onset of the French Revolution. Arriving in London he is reported to have found work as a carriage draughtsman, providing designs for many of the leading coach and carriage builders. Soon after settling in London, Ackermann must have commenced his business as a purveyor of books and prints, since in 1795 he opened a book and print shop at No. 96, Strand, removing during the next year to No. 101. "Here," comments a writer in *The Gentleman's Magazine*, 1834, "by indefatigable industry, intelligence, and enterprise, combined with inviolable honour and integrity in all his transactions, he created that flourishing establishment which has made his name perhaps more extensively known, both at home and abroad, than that of any other tradesman in the British metropolis." Ackermann had been in London for some ten years when, during 1805, he was called upon to supervise the construction of the funeral car which conveyed the body of Lord Nelson for burial at St. Paul's Cathedral. Before this, he had (in 1801) applied for a patent (No. 2491) relating to "Waterproofing woollen cloths and fabrics." In this application there is a co-patentee (James Cuttean, of Bucklersbury), but no specification appears to have been enrolled. Ackermann is described as "of the Strand in the County of Middlesex, Printseller." There is a record of the setting up in Chelsea of a plant for the manufacture of the waterproofed cloth. During 1809, Ackermann commenced publication of the successive volumes of his famous *Repository of Arts, Literature, Fashions, Manufactures, etc.*, which continued to be issued until 1828. It was around 1809 that he became responsible for the introduction of lithography—as a fine art—into Great Britain.

Gas Lighting

Important as were his normal business activities, Ackermann's memory is perpetuated, among engineers, by his work in connection with (*a*) the introduction of gas lighting, and (*b*) the exploitation of the pivoted stub axle with articulated control rod for vehicle steering. Dealing first with gas lighting, it must be mentioned that as early as 1812 Ackermann installed at his shop in the Strand a plant for making illuminating gas, the engineer advising him being Samuel Clegg, who had served his apprenticeship under Murdoch at Soho Foundry, Birmingham. The courage and prescience called for in ordering and installing this plant can be gauged by noting that not long previously Sir Humphry Davy had ridiculed the idea of lighting London by gas. The installation at No. 101, Strand, may likely have been the first private gas-supplying plant in London, and it is on record that Clegg experimented here with dry lime purification. We need not doubt that here, also, Clegg and Ackermann discussed various methods for charging for gas. At all events, three years after making the installation at Ackermann's shop in the Strand Clegg introduced the gas meter, and of this invention the following account is given by Stirling Everard in his book *The History of The Gas Light and Coke Company*, 1812–1949 (Ernest Benn, Ltd., London):

"In July, 1815, serious consideration was being given by the Court (of the Gas Light and Coke Company) to the method of charging for private lights, when Mr. Ackermann, the publisher in the Strand, who previously had made his own gas in plant installed by Clegg a few years before, applied to the Company for a supply. But he insisted that he should be charged by the cubic foot, for, as he explained, it was in his opinion the only way in which he could fairly be charged. As a concession he offered, if the Company preferred it, to make a lump-sum payment of £100 per annum, a figure which would have given him exceedingly cheap gas. It was agreed to charge him for actual consumption at 10 shillings per 1,000 cubic feet, the price which he himself suggested, and one which was lower by some 6 shillings to 8 shillings per thousand than that to the average consumer on the 'permitted usage' or 'rental' basis. The Court decided that this was the opportunity to try out Clegg's new meter, and one was installed in Ackermann's premises forthwith. . . . A year later, in June 1816, the position was reviewed, when it was found that Ackermann's meter was no longer accurate, and the manufacture of meters to Clegg's design was stopped. The experiment had failed. On the other hand he (Clegg) devised also a wet meter for use on the works which was very much more reliable, and, indeed, was the forerunner of the station meters of to-day."

Industrial Use of Gas

It is further related that during 1821 the Gas Light and Coke Company discontinued the supply of gas to the business premises—in the Strand—of Rudolph Ackermann, who had been their first industrial consumer. According to Mr. Stirling Everard's book the Court of Directors "conceived the sole function of gas to be lighting, in which view they differed from Ackermann, the publisher, who without authority adapted it for heating plates, engraving, and making the soot required in his processes. As the first industrial consumer he received the reverse of encouragement, being accused, in 1821, of contravening the terms of his agreement by making daytime use of gas and by having more burners than those specified in the contract, and his supply was discontinued forthwith." Samuel Smiles, in a reference to Ackermann's use of gas lighting tells how "one lady of rank was so much delighted with the brilliancy of the gas-lamp fixed on the shop counter that she asked to be allowed to carry it home in her carriage, and offered any sum for a similar one."

Pivoted Stub Axle

Ackermann also played a great part in the development of the pivoted stub axle with articulated control rod for vehicle steering. We have seen how he had served his apprenticeship as a coach builder and this doubtless influenced him in the interest which he took in a patent (No. 4212/1818), relating to "Improvements on Axletrees applicable to Four-Wheeled Carriages." The application date was January 27, 1818, the specification being filed by Ackermann on June 8, 1818. It is clear from the patent documents that the inventor was Georg Lenkensperger, of Munich, who communicated the invention to Ackermann, described in the documents as an art publisher and print-seller in the Strand, London. The specification contains the earliest description of the pivoted stub axle with articulated control rod connecting the two axles in such a way as to permit them to "turn in their sockets and form the centres round which the axle arms have their horizontal rotatory motion for the purpose of placing the fore wheels in an oblique position when the carriage is to be turned or is in the act of turning round." The means by which any motion given to one vertical socketed axle (or axle arm) is communicated to the other are clearly described. This patent is of historic interest as the parent of the arrangement subsequently adopted as standard on automobiles, the only addition required being means (as by a steering tiller or wheel) for controlling movement of the rod connecting the vertical axles. For some unaccountable reason the arrangement has invariably been attributed to Ackermann, whereas the inventor—as is clearly stated in the patent specification—was Georg Lenkensperger, of Munich. It is known, however, that Ackermann devoted some two years in his efforts to promote the use of the device. Farseeing as he was, he could not have imagined the magnitude of the development which would follow—with the introduction of the automobile—about eighty years later. Ackermann died at Finchley on March 30, 1834, being then seventy years of age, and was buried on April 7 at St. Clement Danes.

There is an article on Ackermann in the Dictionary of National Biography, and at the time of his death a most interesting biographical memoir was printed in *The Gentleman's Magazine*, No. 1, 1834. This records Ackermann's conspicuous devotion to the cause of those suffering in the European wars of the early years of the nineteenth century. He it was who provided the leadership in efforts for the relief of the fatherless and widows after the battle of Leipzig and he was ever ready to aid *émigrés* from Europe irrespective of the country from which they came. Of Ackermann's efforts in connection with the promotion of the gas industry the writer in *The Gentleman's Magazine* remarks that "His speculative and enterprising disposition showed itself in various ways unconnected with his trade. We believe that we are correct in stating that his was the first private establishment in which, before the formation of gas companies, an apparatus was erected for making gas for the purpose of domestic illumination."

We hope that in the restoration of St. Clement Danes due attention will be devoted to the commemoration of those famous people who were brought there for burial. Among them was Rudolph Ackermann and many are the engineers who would rejoice to see a tablet erected to his memory.

Graphical Method for Oblique Bending

By T. F. W. SMITH, B.Sc. (Eng)., A.M.I.C.E. A.M.I.Mech.E., A.F.R.Ae.S.*

Graphical constructions, using the Mohr area moment circle, are described for locating the neutral axis and for drawing the stress distribution diagram for a beam section subject to oblique bending.

THE bending stress f at any point in a beam section due to a bending moment applied about a non-principal axis of the section may be found from the relationship $f=M_n y_n/I_n$ where M_n is the component bending moment about the neutral axis, y_n is the perpendicular distance of the point from the neutral axis, and I_n is the second moment of area of the section about the neutral axis.

The location of the neutral axis and the operation of the formula $f=M_n y_n/I_n$ may be carried out graphically by making the following constructions on a drawing of the beam section. They produce, to a calculable scale, a diagram of the stress distribution across the section.

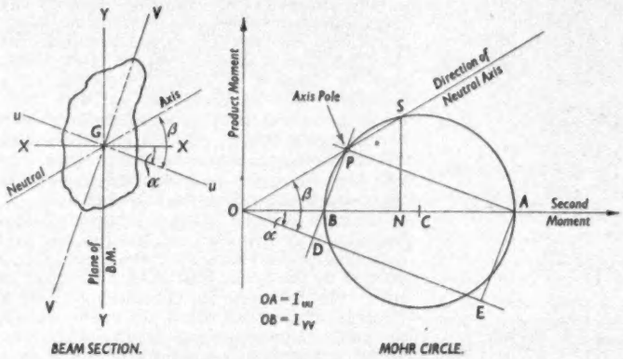


Fig. 1—Use of Mohr circle pole to locate neutral axis

To Locate the Neutral Axis and Find I_n

In general, if the Mohr area moment circle be drawn for a beam section with the second moment axis of the circle in the direction of the axis about which the bending moment is applied, then the line joining the axis pole[1] of the circle to the origin gives the direction of the neutral axis. This may be proved by reference to Fig 1, in which the Mohr circle has been drawn with its second moment axis parallel to XX, about which the bending moment is applied. The axis pole P has been located by drawing AP parallel to the principal axis uu and BP parallel to VV.

To show that OP gives the direction of the neutral axis draw OD parallel to uu and drop the perpendicular AE on to its extension.

Then

$$\tan\beta=\frac{PD}{OD}=\frac{AE}{OD}$$

but

$$AE=\frac{OA}{OB}\,.\,BD$$ from the similar triangles OAE, OBD.

therefore

$$AE=\frac{I_{uu}}{I_{vv}}\,.\,BD$$

therefore

$$\tan\beta=\frac{I_{uu}}{I_{vv}}\cdot\frac{BD}{OD}$$

therefore

$$\tan\beta=\frac{I_{uu}}{I_{vv}}\tan\alpha,$$

which is the correct relationship between the angles β and α for the neutral axis.

From the properties of the pole the point S, where OP again cuts the circle, has co-ordinates giving the area moment values for the neutral axis. Hence ON gives the value of I_n. This construction may conveniently be made on the drawing of the beam section. Fig. 2 shows this done for an unequal angle section whose principal axes and area moments are already known; in this case it is suitable to take the centroid as the origin for the Mohr circle. Fig. 3 shows a variation of the construction for the case when the principal axes and area moments are not already known and where the Mohr circle has been used to find them by using the centroid as the pole.† In both these cases, provided the bending moment is applied about axis XX, the line joining the pole to the origin immediately gives the neutral axis and ON gives the value of I_n.

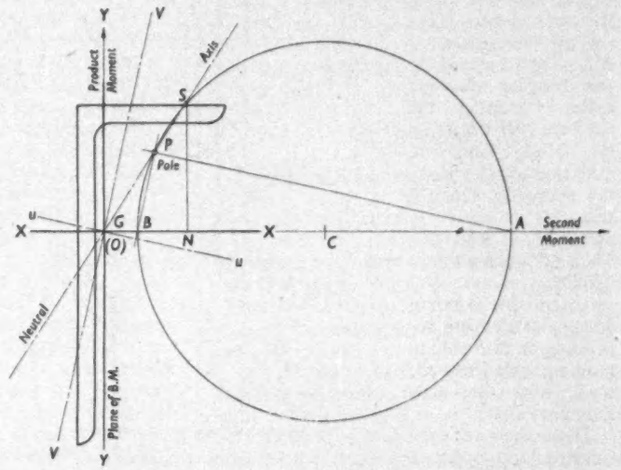


Fig. 2—Location of neutral axis when principal axes and area moments are known

When the neutral axis OP cuts the circle at S so acutely that S, and hence N, is graphically indefinite, the following construction, shown in Fig. 4, may be used to ensure an exact location of N. Draw PP' at right angles to the neutral axis to cut the circle again at P'. Draw $P'Z$ perpendicular to OA. Using the centre C of the Mohr circle draw the semi-circle ZN, thus obtaining a definite location of N.

To Find M_n

Having located the neutral axis, draw axis QQ perpendicular to it as in Fig. 5. On the axis YY, which is the plane of the bending moment, set up GF to represent to

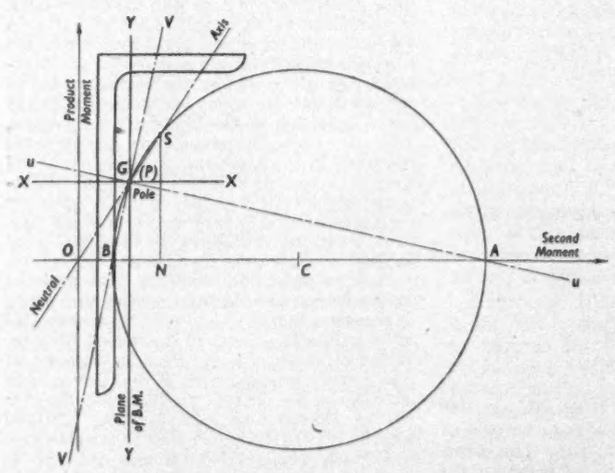


Fig. 3—Location of neutral axis when Mohr circle has already been drawn to find principal axes

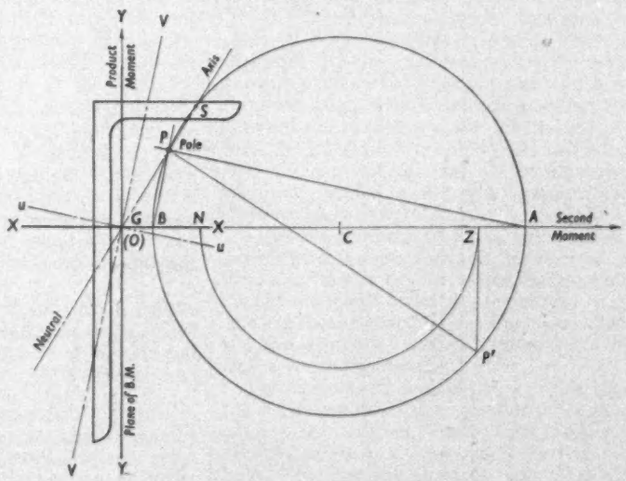


Fig. 4—Location of N when S is indefinite

* Senior Lecturer, Mechanical Engineering Department, Brighton Technical College.

† Smith, T. F. W. "Uses of the Mohr Circle Pole." THE ENGINEER, November 11, 1955.

scale the applied bending moment M. Drop the perpendicular FH on to QQ. Then GH gives the component bending moment M_n about the neutral axis.

To Determine the Stress Distribution

The stress distribution diagram may now be constructed as in Fig. 7. Set out, along the neutral axis, $GJ = GH$ by swinging the arc HJ. Then $GJ = M_n$ to the bending moment scale. Transfer the distance $ON = I_n$ from the Mohr circle to GK along QQ. Erect the perpendiculars JL and KL as shown to cut at L. Join LG. Then LG is a line whose ordinates from QQ represent the bending stress f to a scale depending on the bending moment scale, the space scale and the area moment scale.

This is shown by considering any ordinate RT. From the similar triangles RTG and KLG, $RT = KL.RG/KG$ but

$KL = \frac{M_n}{a}$ where the bending moment scale is a tons-in to 1in.

$RG = \frac{y_n}{b}$ where the space scale of the beam section is $b$in to 1in.

and

$KG = \frac{I_n}{c}$ where the area moment scale of the Mohr circle is cin^4 to 1in.

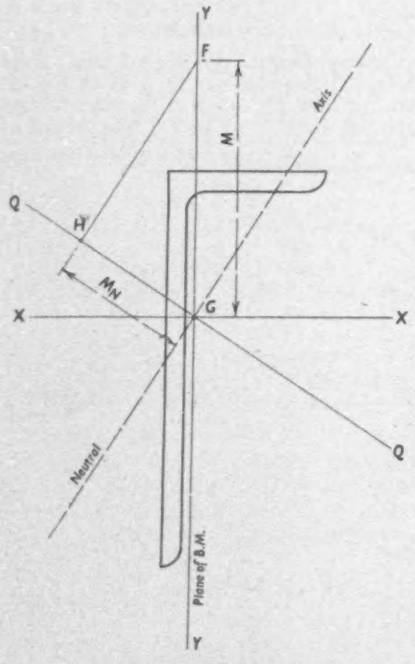
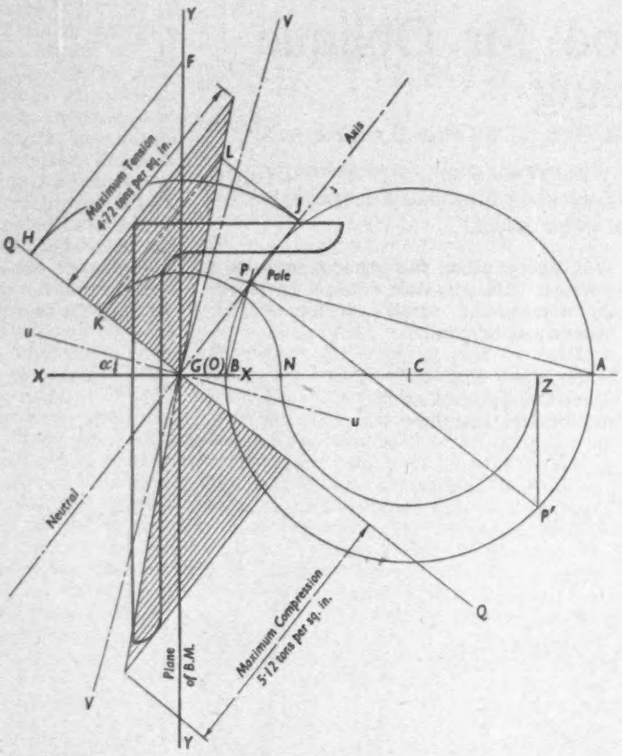


Fig. 5—Determination of M_n



Section—8in by 4in by ½in B.S.U.A.
$I_{xx} = 40{\cdot}28\text{in}^4$, $I_{yy} = 4{\cdot}18\text{in}^4$, $\alpha = 14\frac{1}{2}$ deg.
B.M.—30 tons-inch hogging about XX

Scales
B.M.—1in = 10 tons-inch
y—1in = 2in
I—1in = 10in^4

Therefore stress—1in $= \frac{10 \times 2}{10} = 2$ tons per square inch

Fig. 6—Example of complete construction results

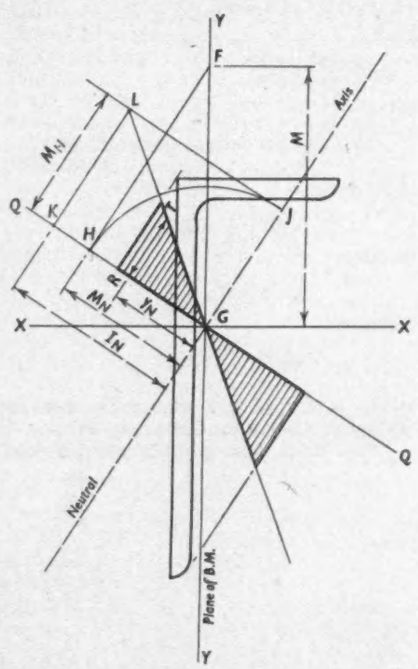


Fig. 7—Construction of stress distribution diagram

therefore

$$RT = \frac{\frac{M_n}{a} \cdot \frac{y_n}{b}}{\frac{I_n}{c}} = \frac{\frac{M_n y_n}{I_n}}{\frac{ab}{c}} = \frac{f}{\frac{ab}{c}}.$$

Hence RT represents the stress of f at this distance from the neutral axis to a scale of ab/c tons per square inch to 1in. This stress scale is easily remembered as being of the general form

$$f = \frac{My}{I}, \text{ viz. } f \text{ scale} = \frac{(M \text{ scale})\,(y \text{ scale})}{I \text{ scale}} = \frac{ab}{c}.$$

The stress distribution diagram may now be completed by drawing the stress ordinates through the points on the beam section furthest from the neutral axis, giving the shaded diagram in Fig. 7. The extreme stresses may now be scaled. Their sign will depend on the sign of the bending moment and will be obvious once the diagram is drawn.

Fig. 6 shows the complete construction and its results for an 8in by 4in by ½in B.S.U.A. subjected to a hogging bending moment of 30 tons-in about the axis XX, the principal axes and area moments being already known from tables.

Progress of Indian Steel Plants

The annual report of the Ministry of Steel, Mines and Fuel, the Ministry in charge of the three new steel plants, expresses fear that the production of saleable steel from these plants may be delayed by over six months. The Rourkela plant is being set up with West German aid and technical assistance is reported to be lagging behind schedule and the rolling mills in particular are making poor progress. The first blast-furnace is now expected to be commissioned by the end of this calendar year.

The plant at Bhilai, Madhya Pradesh, which is being built with Russian aid, has run into port difficulties at Visakhapatnam, which was initially selected by the Soviet experts for the import of equipment and machinery from the Soviet Union. Experience has shown that it will not be possible to handle all the shipments in this port in time, as the port is finding it difficult to handle ships of the kind chartered by the Russians. As the port of Calcutta is already handling the import of equipment for the Durgapur, Jamshedpur and Burnpur plants, it has been arranged to receive at Bombay three ships a month containing such cargo as can be conveniently transported by rail to Bhilai, about 500 miles away. Meanwhile, facilities at Visakhapatnam are being improved. It is hoped to commission a blast-furnace at Bhilai before the end of the year.

In Durgapur, the difficulties so far have mainly centred on civil engineering construction. The ground conditions have proved more difficult than anticipated. Recently measures required to overcome likely difficulties were discussed with the British contractors and consulting engineers, and work there is now proceeding according to schedule. There is reason to believe that the original dates of construction will be maintained, except in one section—the wheel, tyre and axle plant—where large-scale revision of the original specifications has been necessitated by changes in the requirements of the railways. The first blast-furnace at Durgapur is to be commissioned by the end of October, 1959.

The report states that the development of the various mineral resources required to feed the three plants is not in pace with the construction of the plant in all cases. Supplies from the Taldih iron ore mines will not be available for the Rourkela plant until the end of 1959. Meanwhile, ore will be drawn from existing market sources in the Gua region and stockpiled for the initial operation of the blast-furnaces. Again, until the washeries programme is completed (probably in 1960), selected unwashed coals will have to be used at Rourkela and Bhilai. Limestone supplies for Rourkela and Durgapur are both presenting difficulties and a new ore mine to be developed at Rajhera for the Bhilai plant will not be ready until after the steel works.

Plant extensions to the Tata steel works at Jamshedpur and the Indian Iron and Steel works at Burpur, are progressing well and are expected to be largely completed by the end of this year. With their completion and the commissioning of one or two blast-furnaces of the Government steel works, the pig iron production is likely to rise to 320,000 tons this year and 1,250,000 tons in 1959. The production of saleable steel which was about 1,340,000 tons in 1957, is expected to touch 1,450,000 tons this year and about 1,800,000 tons by 1959.

More Wear and Tear

By J. E. JOHNSON, M.I.R.T.E.*

During the 1956–57 lecture session of the Institute of Road Transport Engineers there was presented a paper entitled "Wear and Tear." During the 1957-58 session a sequel was given by the same author, from which we reproduce abstracts below.

Tyres

As the tyre bill is always to the fore in operating and repair costs, a further look at this ground-floor subject may be of interest.

It is now clear that with a fair amount of care and attention, the tyres and maintenance bills can be nicely reduced if good tyre control can be applied. Ever since the early days of pneumatic tyres on goods vehicles, tyre and mechanical failures have usually been treated as separate items of expense, and only in knowledgeable quarters has any sound method of tyre control been applied. Far too many hauliers treat this subject as a matter of good or bad luck and usually leave the tyre fitting and changing to junior or unskilled labour, often without engineering supervision of any kind. Furthermore, the matter of attention to tyres and inflation is often a very hurried job, done by a driver or mate, who will kick the tyre rather than use a gauge, the kick or hammer blow being an accepted drivers' check over the years, and until a series of tests was carried out by the writer, he also failed to be alarmed.

However, tests were made, using one hammer, one new gauge and a pair of good boots. These were the tools, plus a pencil and paper. Ten 40×8 and six 36×8 were each hammered, kicked and then the pressure checked. In each case the noise was the same. The hammer flew back a similar distance, and the writer's foot became more and more painful, only the unbiased gauge showing a true picture, as follows; on the 40×8 tests : 90 lb, 91 lb, 84 lb, 77 lb, 80 lb, 65 lb, 90 lb, 81 lb, 89 lb, 89 lb per square inch—on the 36×8 test : 85 lb, 88 lb, 70 lb, 97 lb, 74 lb, 80 lb per square inch.

This initial test raised enough interest to justify a further series of tests which again proved that no true idea of pressure could be obtained from kicking or striking the tyres.

Very evident also is the apparent absence of any satisfactory remedy for the problem. The engineer could supply a reliable gauge to each driver and check pressures daily, although in many cases there would be no air available for inflation, or he could attempt to organise call points for tyre checks. This latter was partially organised, but fell down frequently, where out-of-the-way calls were made, or where drivers lost interest in this duty.

A third method entailed fitting a certain number of vehicles with an air pump or having the location for a pump available on the gearbox side. This appeared to be the answer until the discovery was made that the pump did not give above 80 lb, and 90–100 lb was often needed. Other models had air brakes, and modifications were again considered to give access to the stored air. Again this was a problem, as the vehicles in question had a maximum brake pressure of 80 lb. Pushing up the brake pump to over the 100 lb solved the inflation problem but upset the braking system.

An air cylinder was carried but did not have the capacity to deal with more than topping-up once round or inflate fully one tyre if flat.

After a period of time it was considered by the engineer that the only hope was suitably to excite the driver into a more tyre-conscious way of life, at least, while on duty. Suitably worded instructions were posted in the cab, notice boards showed tyre costs and reasons for these. One point in particular was emphasised by the engineer, namely, wherever possible at any stop *en route*, the driver should feel each tyre by hand, and a soft tyre would be noticed at once by its raised temperature, often before becoming ruined by further dragging.

"Tyre drag" has been mentioned in the previous paragraph and was dealt with at length in "Wear and Tear."† It was hoped at the time of writing that paper, that manufacturers would finally agree to a fixed outside diameter or rolling radius between various makes of the same size. A recent check has, unfortunately, shown that there is still a large variation in dimensions between makes, and that remoulds also are found to be away from the original measurements. It is true that a little improvement has been made, but it is still possible to have up to 1½in of diameter variation in the popular large sizes, in both new and remoulded tyres. The effect of this is obvious in varying revolutions per mile and loading per tyre.

As the majority of the larger vehicles is still using the two-differential double drive, perfect tyre matching must be maintained, for otherwise, rapid wear of both tyres and differential parts will soon be evident.

A well-matched rear bogie will give long life to both tyres and differential units, and can make a difference of 10–15 b.h.p., with a substantial saving of fuel and a certain rise in total engine mileage.

It will be appreciated that due to diameter variation, one make only must be in use on the bogie wheels, or to be more sensible, one make all round the vehicle, This will allow a periodic move round and will share the rate of wear over the twelve tyres on the floor. The spare, of course, should take its turn on one of the steered wheels, and not be left as new on the carrier, to throw the rest out of step at some later date. This, unfortunately, is all too prevalent on many vehicles.

It is noticeable that the four steering tyres seem to have a varied rate of wear, and the pair on the braked axle naturally wear faster than the idle ones. Again this calls for a change round at frequent intervals to obtain the best from the whole set, and at the same time to take care of the small irregularities common to steered wheels, even on new and correctly aligned vehicles.

Returning to driving axles, opinions differ in relation to single- and double-drive, but it is obvious that single-drive multi-wheeled vehicles and trailer will be fairly expensive on the four driving tyres unless their capacity for work is further improved. For the long-distance heavy haul there is much to be said in favour of the double-drive, where eight tyres instead of four handle the horsepower delivered.

Another headache for the engineer who has vehicles on trunk services to London, is the menace of kerbing, and this appears to be a regular happening where the vehicles have to cross the Thames and go under instead of over. The practice seems to be to point the vehicles towards the kerb as a guide through the tunnels, and the result is damage and heavy scuffing on the near-side tyre walls, with eventual failure.

Constant arguments have failed to alter this particular form of expense, the usual story being that on entering the tunnel, the driver is more or less blind and uses the kerb to maintain his near-side position. Quite an expensive method of crossing the Thames, and the only possible answer is, of course, "keep out."

Tyre Fires

To add a little warmth to this subject of tyres, a look at another problem, tyre fires, may be interesting.

As we know that a flat tyre can take fire, and quite frequently does, what is the driver expected to do when this really happens ?

A tyre fire is usually on the rear bogie and can, unfortunately, be very close to the fuel tank.

On a multi-wheeler the driver is often unaware of trouble until either flames show in his mirror, or he is warned by other traffic that he is travelling with trouble. He then has quite a problem. He can do one of several things. He can stop and hope to deal with the occurrence, with help if available, and call the brigade, or try to smother the fire by earth or any other means available. His other choice is a drastic one, but with luck he can often save disaster. He can, if the road is clear, press on, and can burn off the offending tyre with a rather awe-inspiring catherine-wheel display until the burnt remains fly off.

Though contrary to regulations and everything else, this is, and has proved, the safest method in an emergency, where a driver is away from any town, and there is no sign of assistance available.

Over a number of years of experience with similar fires, the majority of complete burn-outs has been due to the driver stopping in some isolated part of the highway, and the flames have then caught hold of ropes, sheets, woodwork, and invariably exploded the fuel tank, the vehicle then being destroyed, including the customer's load.

The other method, however drastic, has saved a vast number of major occurrences. The burning off has, no doubt, damaged the other tyre by heat, but in the majority of cases the fire has remained inside the mud-guard area, and burning tyre and tube have flung off safely with little other damage, the forward motion keeping the heat back from the fuel tank, and the catherine-wheel effect of the flames not allowing any concentrated intensity. Professional drivers have used this method for many years.

Little is said about tyre fires, and certainly no printed information or instruction is available, but it can be stated with safety that in the hands of an experienced driver, a tyre fire can be controlled, but in cases where this knowledge is lacking, a vehicle can be lost or seriously damaged.

The engineer in charge of a trunk fleet can do or say little in this matter other than acknowledge a rather "dodgy" but extremely effective method of overcoming the tyre fire bogy. No one can, or will, say, after the occurrence, that a tyre was soft or flat, the

* Works Engineer, British Road Services.

† The Engineer, May 19, 1957, page 605.

important thing being that a tyre had burned off, with no other material damage than the tyre and tube destroyed, and the rear wing well and truly paint-stripped.

Vehicle Fires

The connection between tyres and fires has now been reasonably aired, but other forms of conflagration are always available to add to the labours of the engineer and his team.

Nowadays, the lessening number of petrol vehicles has helped in reducing the one-time ghastly affairs that not infrequently lit up the night skies.

It is now possible to have an outbreak of some considerable size and still finish with a full tank of oil fuel. Sometimes, however, up goes the tank and then usually all else. How did it all start ? Quite a number of people wish to know this. Usually the engineer is at the end of the queue, as he is probably already assessing the damage and trying to remember if he still holds that spare cab frame. To look at the varied causes will produce the following. First, tyres, which we have discussed already ; secondly, electrical ; thirdly, hot exhaust pipes and, on occasions, the load, which, if of a certain nature and allowed movement and friction, will ignite ; lastly—the one which started for no reason at all. We will begin with that smell of burning rubber. It may start with a worn-through power line, and eat along unnoticed, until some unit fails, or the driver's attention is attracted by sight or smell, or both. He stops at once and is aware of melting rubber and a glowing harness or wiring loom. The next step should be easy. But is it ? All he has to do is to disconnect the batteries or break one line.

The main starter cables do not break and the terminals do not lift off the posts. A spanner is needed, but of what size ? He has one in his pocket, a quarter by five-sixteenths. This fits one nut only and is no good because the bolt turns due to corroded corners on the head. The quarter spanner does not fit the other nut, that appears to be one of those without legal parents.

It is indeed strange that throughout the years engineers have stuck to this double event in fastening a battery terminal. However, the driver does not know or care about the inside of electrical fittings ; he has a fire on his hands and no help. The jack bar is tried next and does no more than smash the top of the battery. Eventually, the line is broken, the power is cut and the burning can be extinguished. If lucky a rewire will put things in order, but on occasions worse happens and woodwork, canvas, roof, seats, &c., light up and the matter is beyond control, ending in a carry home, strip and rebuild.

The writer's records show that in 11,500,000 miles travelled over trunk routes, sixteen vehicles were damaged by electrical fires, small, medium and large amounts of damage being the result. In all but three cases the vehicles were middle-aged, well-used models where many wiring repairs had been carried out over the years. Some of the installations were in cotton loom, P.V.C. casing, sleeving, and only two in steel conduit. The two steel-tube systems had both fired at a screwed joint that had broken and escaped attention. In any case, these two fires were of negligible severity, as the conduit had allowed the wiring to burn more or less harmlessly. The cotton-loom system really burned and a considerable amount of damage was suffered. The sleeving and P.V.C. jobs also burned and were expensive repairs. The ideal arrangement is very obviously steel conduit, or steel flexible pipe carefully arranged to take into account vibration and flexing of scuttles and dash assemblies. Also it is clear that the driver is indeed helpless unless the battery can be quickly disconnected.

The petroleum tanker and chemical transport people usually provide a sound master switch near the batteries to allow instant isolation of the main electrical supply, and such a thing as an electrical fire is a rare occurrence. A heavy-duty plug and socket combination can also be used as an easily detachable main battery lead. This is quite easily rigged and takes the place of a master switch.

While writing, it is a relief to find that a certain manufacturer of battery-pole terminals has now standardised his bolts and nuts, and provided the bolt does not turn on its square, a quarter by five-sixteenths spanner should undo both positive and negative if needed.

Further on vehicle fires, there is the dangling rope end which finds its way between cab and headboard, and coming into contact with the hot exhaust pipe, is soon alight, especially if climbing a steep hill under full power and heat. This, unfortunately, happens behind the driver's back and can be well under way before discovered. The answer to this is, either a front exhaust system or a steel sheet between cab and body, completely to shield the exhaust area from ropes, sheets, &c. A rope end dropping between cab and body will dangle and swing round and be a general nuisance in many ways, and this shield will serve a number of purposes apart from fire prevention.

There are still one or two other causes that have been known to start serious fires. Certain materials carried by road can, if conditions are right, self-ignite or can fire due to friction-generated heat. Fortunately, this does not occur very often, but the writer has notes on one or two affairs that did start entirely on their own. One such instance was in transporting 3-ton rolls of paper which had been allowed to rub together, due mainly to lack of correct loading or chocking. This fire started amongst the load, but it was never satisfactorily settled as to whether the fire was the result of the pressure of two rolls of paper igniting themselves or if, in fact, the rolled-up tarpaulin became jammed between two rolls and started to smoulder due to friction, the main point being that a fire did commence. The load was damaged by fire and water and a replacement body was needed. The lesson learnt was with all such future loads to keep heavy circular items apart by suitably timbering or chocking.

Another somewhat mysterious fire in which vehicle and load suffered was finally diagnosed as spontaneous combustion, the load in this case being bales of old rags and rather oily cleaning material. In this instance the fire started while the vehicle was at rest. As the load had been on the vehicle for eleven hours' running time and around one hour standing time, it could only be assumed that the lowest bales had self-ignited.

The writer had experience recently of a serious burn-out started in a most unusual manner. The vehicle in question was ten years old, but quite serviceable, and a reliable money-spinner. The batteries were carried under the mate's seat, and when the vehicle was much younger, had had covers fitted over the battery tops. At some time during its life, a fitter or electrician had experienced trouble in removing or fitting the covers (usually in their removal) and had probably slung the cover away in disgust. However, in due course, the driver's seat became the worse for wear, and he exchanged his worn cushions for the less-used and less-worn mate's seat. The seat cushion in question was of wire mesh and spring construction with a layer of cotton waste and felt secured below the leather top. During its long life the worn seat had, without completely falling to pieces, broken quite a number of wire strands which eventually came through the bottom cover of hessian, and in due course, made contact with the battery cell bars below. This, of course, was not known until afterwards. However, while investigating the damage and debris, strands of spring wire were found securely welded to the battery-cell bars, which had, remarkably enough, survived the blaze, and an idea was then formed as to the cause of the fire, which until then had been a mystery. To prove this point, an old seat was found and suitably unstranded to a worn-out and stringy state. A 12V battery was obtained fully charged, and a test was made. Obviously the writer knew that sparks would fly when the stranded wires made contact with the battery, but he was really shaken by the speed of the events that followed. On contact being made, and the usual " spat " of a short circuit, the whole of the wire springs and mesh warmed up at once to a red glow, and before the seat could be torn free, the padding and cover were in flames. On it being literally kicked free of the battery, the seat continued to burn to destruction. From that time battery boxes were made or lids fitted and all seats came in for regular inspection.

Vehicle Accidents and Damage

Records show a number of cases where mechanical failure has indeed been the cause of accidents and this may be well worth a hearing.

A regular cause of winter brake failure amongst the servo models is, of course, the freezing of main servo atmospheric valve, due to the presence of moisture on the piston rubber. Quite a number of vehicles have the servo mounted on the outside of the chassis frame, and often more or less in line with the front tyre, which flings up water, mud and everything else directly at the valve casing, and the sock-covered rod entry port. In older vehicles, this sock can be cracked or perished, and can, quite unnoticed, allow a considerable amount of water to pass directly into the interior of the servo. Regular draining at both sides of the main piston is recommended, and if at all possible a shield is of value if it can be fitted in front of the servo, or mudguard flaps can be fitted which will eliminate the dangers of water flung up from the tyres.

On air brakes the same danger exists from water collected within the air vessel, and travelling to valves, causing freezing and locking up. Fortunately, an anti-freeze device is now on the market which is of value in preventing this trouble. Having had one or two systems so fitted, the writer can testify to its efficiency. Also in wintry weather trouble has been experienced where a cheap brand of brake fluid has been used, and the trouble has been brake failure due to solidifying or jellying of the fluid. This has happened at times, mainly at night, when the temperature has been really low. In cases such as these there is only one answer with brake fluid, use only the genuine article which is designed for the job, and keep off the apparently cheaper fluid. Engine oil fuel also suffers from this trouble where the pour point or jelly point is too high. With fuel, the pour point is fixed in the processing and can be adjusted to a lower point if specified by the engineer. Certain fuel people stick to the

same figure winter and summer. A vehicle travelling at a fair speed during the night may, during the early hours, experience conditions equal to 25 deg. or 30 deg. of frost and with a high pour point, oil will grease up or jelly. This is worth adjustment during the winter months where night trunks are operated. This is slightly off the subject of brakes and accidents, but has tied up with trouble from time to time.

A point concerning air brakes has intrigued the writer for a number of years. This is the air vessel fitted to such vehicles. In any factory or garage, an air vessel or receiver is treated with great respect. It is regularly inspected, cleaned and usually insured, but on the road vehicle this still-lethal cylinder is never thought of, despite its all-weather service.

Quite recently an air cylinder relief valve seized and the cylinder exploded, blowing a large piece out of the body, luckily with no loss of life. The engineer is wise to check these cylinders at intervals for dents and rusting. As there is rarely a sizeable inspection hole, little can be learned of the interior. If the engineer is so inclined, he can carry out a cold water pressure test with the vessel off the vehicle, and can take his test load carefully up to two-thirds above working pressure. The safest method is, of course, hand pumping, with the cylinder suitably caged off.

Regular attention to the relief valve is important, especially of the control spring, which may, if left undisturbed for a long period, become solid with rust and resist blowing at top working pressure, causing a dangerous rise.

Again the writer begs to stress the importance of using only genuine hydraulic fluid, plungers, valves and cups. Many instances have been recorded where rubber cups, glands and seals, have been attacked and destroyed by the use of cheap pirate fluid which had a destructive action on the units. One such instance will always be remembered by the writer, as a driver lost his life due entirely to complete loss of brakes. Investigation of the master cylinder showed that the main rubber cup had been literally reduced to pulp by the action of some cheap unknown fluid.

One obvious cause of accidents is, undoubtedly, the bad habit of driving to the limit of a vehicle's stopping ability. To look back briefly into past years, when driving ex-W/D 1914–18 model Peerless, or similar solid-tyred machines, any descent was treated with great care when loaded. Being fitted with rear and transmission brakes only, and only manual effort being available, a stop was made at the top and the lowest ratio engaged, the vehicle then being more or less lowered carefully over the edge, usually with the ignition switch off, and a foot braced against the dash to help pull on the hand brake. In those days no risks were taken and it was not uncommon to see a driver's door off the catch both downhill and uphill.

Compare the two to three dozen items comprising the whole brake system then in use, with the modern hydraulic-boosted multi-wheelers with automatic adjusters that have some 400 separate bits and pieces to supply brakes to the vehicle. The power now available at the touch of the pedal tends to give a sense of security that may be misleading, and all too often drivers can be seen approaching and descending quite steep hills at really dangerous speeds which, from time to time, produce an accident. It is difficult to point out that any system can be overstrained and frequently is, due to this bad habit. Tyres, wheel studs, " U " bolts, brake back plates, and the power units themselves, all suffer through abuse of this high braking power.

From time to time we are troubled with the accident where a vehicle has failed on a hill and run back out of control, with the usual ditching or overturning and resultant damage. The most remarkable thing here is that in all probability it is one of our newest and most powerfully braked vehicles.

We will select one of these incidents where a vehicle ran back downhill and crashed heavily with a near-major rebuild. The hill in question is on a main road, gradient one in six-and-a-half, plus one rather deceiving adverse-cambered bend where the gradient rises to one in five-and-a-half on the inside. In other words a normal busy British main road. The vehicle is a heavy modern eight-wheeler, mileage around 55,000 from new, fitted with hydraulic engine-boosted brakes, two-leading-shoe action, and everything made very sure and easy for a first-class stop from speed. Coupled to this is a crawler or super-low bottom gear which, with 125 b.h.p. available, will take 24 tons gross anywhere on main roads in Great Britain. The driver is average, not widely experienced but normally able to cope in most cases, and travelling a regular 900 miles per week on trunk work. The vehicle is fully loaded and the approach to the hill is normal. As he climbs he finds revolutions per minute dropping, and goes down as far as normal low. Super-low is not good to get if climbing and is not often needed, so rarely in fact that he has never practised it without a full stop.

However, as the revolutions again drop, he has a dab at engaging crawler and misses. In a second or so he is on the move backwards and slams on the hand brake, which can be ratchet, straight fulcrum or eccentric wheel and chain. It can also be on his left-hand side and horizontally positioned. All he has to do is to lock it on, get his breath back and either try to take off again, or lower the whole lot slowly downhill for a new attempt. Unfortunately, none of this works, and the driver is now in neutral with the engine stopped and no boost to the foot brake, or in gear with the engine being turned in reverse, and again no boost.

Not helping, is the fact that there is no leading-shoe action, just whatever he can obtain by brute force from pedal and direct Lockheed, and the vertical-lift hand brake which is most effective when the left arm is at its weakest pull point, i.e. nearly at right-angles. With this he attempts to stop twenty-four tons going backwards at around 10 m.p.h. and pushes and pulls until he has no strength left to steer, and quite frequently heads the wrong way.

Surely something is very wrong with this set-up and should be corrected at once. Let us see if this " something wrong " can be pin-pointed. First the brakes. As a high value boost is used for normal operation, it is now the practice to use a type of liner of somewhat reduced friction value, i.e. a moulded one, it being understood that if the higher-value linings, such as woven, wire bound, &c., were used, horrible things would happen to brake back plates, axle brackets, &c. So for a smooth no-fade brake, moulded are fitted. It appears that the higher the boost power available, the lower can be the friction value of the liner used.

Secondly, a two-leading-shoe system is one-directional, no added assistance via shoe design is available if running backwards.

Thirdly, boost drive. This can be engine or gearbox driven, either through constant mesh or an auxiliary device, but again it is effective only if the engine is running.

Finally, as to brakes. The hand brake is, of course, designed to hold the vehicle when loaded, but not all drivers are able to lock it on with enough strength to hold the vehicle on a steep hill. Normally, if the engine is running and the boost is working, the shoes can be locked on first by the footbrake, and held in that position by the hand brake. But can the hand brake alone hold the vehicle at all times during the normal liner life ? In many cases it can not, and yet a brake test forward would be passed easily. It is no use whatever adjusting all brakes and doing a road test, unless a loaded reverse test can be made minus boost, and that is not always possible. Again, over a period, the brakes can lose some value by miles run, and heavy usage between checks, and whilst they may be absolutely safe forward, they are possibly of little or no use in reverse and unboosted.

So the point made is that a vehicle can run away backwards, especially if not boosted at the time, and at the moment little can be done about this. One answer would be, of course, to reduce some of the higher boost pressures, and use the higher-value liner, as in the case of servo vehicles, which use similar hand brake gear but are not so prone to run away. Secondly, better positioning of the hand brake. Line this up with the foot operation so that one can be levered off the other, i.e. hand brake coming to the vertical, spot-in-line with the right foot. This is the best possible positioning. Finally, a foolproof emergency storage of boost that is ready at any time for such a situation. On an air system, of course, arrangements can be made to cover this by emergency brake detail, i.e. separate storage tank, control, &c.

After the various accident repairs and rebuilds, the steering must be tracked and aligned on all vehicles, and a useful point can be mentioned here. Trial and error over the years have shown that greater accuracy in the work of setting steering gear is attained with the vehicle loaded. This point seems odd, and often impracticable, but there is now no doubt that a vehicle set up correctly when empty will show a difference when checked loaded. So for the best steering results, and to give tyres every chance, set the steering reasonably correct on assembly, but re-check when loaded, and spot-on settings are then assured. With the latest sighting tackle this is the work of a moment, and if the error is there, only good can result from the extra work necessary.

While on this subject of accident damage and repair, especially to front-end crashes, a very important point should be remembered before re-assembly. This is steering components. After any bump or crash all steering arms and levers should go through the crack detector.

The writer has vivid recollections of two steering items, i.e. one drop arm and one steering-box spindle which were nearly re-fitted to the repaired vehicle after front-end impact with a tree. Almost out of curiosity at that time, when magnetic crack detection was new, these items were sent for test, although both appeared perfect and rang like a bell when sounded. Imagine the shock experienced when the reports came back—the drop arm had an 87 per cent internal fracture, and would have snapped in two at the first large stone, brick or kerb, despite the unbroken surface and beautiful bell-like ring. The steering-box spindle had sheared internally to within $^{3}/_{64}$in of the outer surface, and was literally held together by the outer case-hardened shell, having an 82 per cent separation internally. These two items are still retained as a strong reminder that in our trade " face value " is of no value at all.

LETTERS AND LITERATURE

Letters to the Editor

We do not hold ourselves responsible for the opinions of our correspondents.

COMPREHENSIVE LIST OF ENGINEERING RELICS

SIR,—It is a matter of considerable satisfaction to the Newcomen Society that you have referred in the leader of your issue of July 11 to the discussions recently held between the Society and officials of the Ministry of Works on the important question of the preservation of engineering relics. This leader will bring the matter to much wider notice than the Society itself could command. As you rightly say, the question under discussion was primarily the preservation of historic relics on site—and these two last words should be emphasised—as affected by the Acts of 1947 and 1953. The important point here is that while these Acts provide for the preservation of buildings of historic interest, no provision is made for the preservation of buildings, themselves of no historic or architectural value which, however, are housing machinery of historic importance in itself. Nor for the preservation on site of the contents of such buildings. That briefly is the problem and it brings me to one of the pertinent questions raised by you. How is a "relic" to be defined? I suggest that if we knew a simple answer to that question half our problem would be solved, but I think, perhaps, that the best selection from the many definitions in the O.E.D. to apply to the present case would be "any object invested with interest by reason of its antiquity or association with the past." This, however, would have to be qualified or expanded to include specific association with the historical past of engineering and technology, and especially with any particular phase or development in that history. For example, as you rightly say, among other items the attention of the Ministry has already been drawn to the Stretham engine and scoopwheel and to the Coalbrookdale furnace. The importance of the latter derives, of course, from its association with Abraham Darby I and the first commercially successful smelting of iron by coke carried out by him in that furnace at the beginning of the eighteenth century. The Stretham engine and scoopwheel are, perhaps, less familiar to your readers. It is the last remaining example of the original steam engines, first adopted in the Fens in 1821 to supersede the windmill driven scoopwheels which were then failing to cope with the falling levels of the land and the increasing difficulties of drainage. These two examples typify what I have referred to as "association" with a "particular phase or development" in the history of technology. There can, of course, be other factors, perhaps of lesser importance, contributing to the creation of a historical "relic," association, say, with an individual of importance in the history of technology.

As you have quite rightly emphasised, the Newcomen Society would be as happy to hear from non-members as from members of the Society, and to widen the field as much as possible the Society will welcome any details of any engineering relic which any individual feels should be preserved. As I have explained above, the primary purpose of our discussions with the Ministry has been in relation to relics on site, and machinery housed in buildings not themselves of historic importance, but information outside this somewhat limited field will certainly be welcome. Discrimination in compiling the list for the Ministry must be exercised by the Society but it would be only too grateful to receive particulars which, while not qualifying for inclusion in that list, can nevertheless be recorded. By this means also it may be possible to obtain foreknowledge of relics, of historic and interesting machines and the like, which might otherwise be scrapped and disappear without trace if no active steps are taken to ensure, if at all possible, their preservation. You quite rightly pose the question "how old must a 'relic' be?" The only answer, I think, to be given here is that while a relic, as has been defined above, must of necessity have some association with the past we must not overlook that to-day will be the past tomorrow. Antiquity in such cases is not necessarily the yardstick. A machine in use to-day, representing a significant phase in a particular branch of technology may be superseded tomorrow and thus become a historic relic. That is why the Society would suggest that appropriate machines still in use should also be recorded. It is not the intention of the Society that attention should be directed "only to objects which have no other protection than the Government can afford." You cite the case of the Cornish Engine Preservation Society which, as you rightly say, represents an instance where protection has already been found "by some body or organisation." The Stretham engine and scoopwheel, to which I have referred above, is a case in point. This "relic," I might explain, embodies all the difficulties of definition under the Acts of 1947 and 1953. Its importance to the history of a significant phase in the draining of the Fens cannot be exaggerated. The Newcomen Society has recently formed a Preservation Trust for this plant and the Trust will shortly be issuing an appeal to the public for funds. Here is an example where the whole procedure of preservation has been put into operation by a private body. i.e. the Newcomen Society, as distinct from a Government Department.

As to the final point in your leader, the nature of the information which the Society is wishful to obtain, this can briefly be summarised as (*a*) the site and nature of the plant, (*b*) owner of the plant, (*c*) date of installation or manufacture, (*d*) very brief details of history and significance and (*e*) whether in operation or not. The importance of engineering and technology to the advance and prosperity of this country, and the lead which it has given to the whole world need not be stressed. I fear, however, that the importance of the history of British engineering and technology too often has to be stressed. That, as you know, is one of the objects of the Newcomen Society, and any help which you can continue to give us in the achievement of our present aim will be gratefully appreciated. May I add, for the benefit of your readers, that all information should be sent to the Hon. Secretary, The Newcomen Society, Science Museum, London, S.W.7.

L. E. HARRIS,
President

The Newcomen Society,
South Kensington,
London, S.W.7,
July 19, 1958.

THOMAS GRAHAM MENZIES

SIR,—There cannot to-day be very many engineers who remember Thomas Graham Menzies, C.B.E., M.I.C.E., whose death has just been announced and this for the reason that no less than thirty-four years ago he, of his own choice, decided to go into complete retirement. Why he chose to do this has never been very clear and from the engineering point of view his retirement in his 'fifties was a real loss to his profession.

We who knew him in the heyday of his active career when he was chief of staff in the old-established contracting firm of Easton Gibb and Son, Ltd., recollect a man whose natural insight and acquired skill into all matters connected with civil engineering and his ability to impart his knowledge to others were quite remarkable. It was he who first instigated the experiments which led to the perfecting of the pile extractor and he who originated the idea of concrete batching plants which are now in universal use on big jobs. During the 1914 war he, by a really amazing effort of imagination which rather outran the physical means available for putting it into effect, devised the so-called Mystery Towers, a line of which twenty-three in number were intended to block the English Channel against the passage of submarines.

So has passed from among us a very gifted and intriguing personality who, if his lot had not been cast in the rugged field of civil contracting as it existed fifty years ago, might with equal facility have attained eminence as a University professor.

G. MAUNSELL
J. RENNIE

Westminster, London,
July 21, 1958.

RAILWAYS INTO ROADWAYS

SIR,—Without wishing to enter into the railway into road controversy I feel I must ask Mr. Dobson (issue of July 4) where he thinks he can can catch a train which will do 200 miles in somewhat under three hours.

My usual experience, living 126 miles from London, is that for an appointment at 10.30 a.m. it is better either to go by car or to leave the night before. I may have been unfortunate but no train on which I have travelled in the last twelve months has been on time. British Railways have now replaced the dining-car on the morning train with a

rather uncomfortable buffet car. And far from arriving "fresh and clean for the meeting" one usually arrives in a very grimy state ready more for a bath and change of clothes than for a meeting.

If Mr. Dobson was in fact gazing into his crystal ball and giving us a glimpse of the future (how far distant, I wonder ?) then I apologise for raising the matter.

R. E. LEAPINGWELL

Stores Road, Derby,
July 8, 1958.

Book Reviews

Heat Transfer (Vol. II). By M. JAKOB. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 120s.

THE appearance of the second volume of Professor Jakob's treatise on heat transfer is an important event for all interested in the subject. Since the author's death in 1955, the manuscript, then almost complete, has been prepared for publication by Dr. Kezios ; but the new volume clearly exhibits the qualities which distinguished the earlier one, published in 1949, from all other texts on the subject.

These qualities derive from the thoroughness and integrity of the author, who was concerned to obtain for himself and to convey to his readers not mere knowledge but sure understanding. This is exemplified most clearly in his treatment of previously-published work. Many authors are careless about references, citing those papers which happen to have introduced them to a subject, rather than the original sources. Professor Jakob however always went back to the true starting point, not merely to honour the innovators, which he has done handsomely, but so as to examine their assumptions, correct the misprints, assess the experimental accuracy, and appraise the nature of the mathematical techniques. The significant results of his studies of the literature are presented clearly, and in detail, in his treatise ; his own researches, which are extensive, are presented impartially and in their proper place. The two volumes form a splendid example of scholarliness applied to an engineering subject, which future authors would do well to study.

Broadly, the present volume covers application of heat transfer, whereas the previous one dealt with fundamentals. The major sections include : radiative heat exchange, thermometry, recuperators, regenerators, and various aspects of heat transfer through boundary layers. The first of these is particularly welcome, for only one other textbook deals with the subject in any detail, and many potential users find it difficult. Professor Jakob has assembled almost all the known graphs and tables for angle factors between surfaces, but inevitably the book omits some of the recent work on radiative exchange between gas masses. The author's treatment is open to criticism in some respects. Thus it would have been better, in our opinion, to use less space in describing the methods of calculating heat transfer employed by earlier workers, and to concentrate on recommending one method clearly to readers who have to perform a furnace calculation quickly ; for such recommendations are hard to come by.

The recuperator and regenerator sections are more extensive than any previous treatment in the English literature, and will be greatly appreciated by both design engineers and research workers. The author does not however attempt to discuss constructional methods or the departures from ideal performance which may arise in practice.

The magnitude of the task which the author set himself becomes most apparent in the sections on convective heat transfer through boundary layers. The literature on this subject has grown enormously in recent years, and moreover has been developed by aerodynamicists as well as by engineers. It is not surprising therefore that Professor Jakob, who was trained as a physicist, occasionally puts a foot wrong. For example, in discussing heat transfer with arbitrary surface temperature, he focuses attention on the particular temperature-viscosity law used by Chapman and Rubesin, which is of minor importance, but fails to stress the essential point that these workers were investigating a new family of "similar" boundary layers, namely those with power-law wall-temperature distributions. Judged by the author's high standards, this represents a failure to put the reader properly in the picture. His survey of the available experimental evidence is however admirable and unique.

Taken together, Professor Jakob's two volumes form a first-class textbook for students, source-book for research workers, and handbook for practising engineers. However it must be said that none of these groups will find all that they need. The author's very thoroughness and care for detail have made it necessary, even in a total of 1400 pages, to leave out many aspects of the subject, some of them important. Heat transfer has spread so far into mathematics, aerodynamics and chemical engineering, that no one man can grasp it all. If ever a comprehensive work is to be written on the subject, it will have to be through the collaboration of a team.

Proceedings of the Second Congress of the Federation Internationale de la Precontrainte, Amsterdam, 1955. CEMENT AND CONCRETE ASSOCIATION. 52, Grosvenor Cardens, London, S.W.1 Price 100s.

IN these proceedings are presented some forty papers together with the discussion on them, on certain selected topics related to prestressed concrete, namely, grouting and anchorage systems, problems in the manufacture and use of prestressing steel, factory produced prestressed units and the assembly on site of precast units by prestressing, moment distribution in statically indeterminate prestressed structures beyond the elastic phase and the influence of plasticity on the strength and instability of thin prestressed concrete shells. To these are added two papers, one on a comparative analysis of specifications for prestressed concrete (1955), and the second on the economic advantages of the material.

Such a set of papers is an interesting record of the progress that had been made up to that time on the topics given above. Some of it is of course of pure historical interest since practice has left it behind; some of it, particularly the second section, comprises authoritative statements on the functions and use of prestressing, and parts of it will be of permanent interest, particularly that related to indeterminate prestressed structures, although a number of the British contributions are available in other publications. It is perhaps interesting to record that the third congress had little new to add to the first and third topics listed above. It is perhaps a pity (although the difficulties of a multi-lingual publication are appreciated) that such a collection of papers has taken so long to see the light of day particularly since it has been overtaken by the third congress held recently in Berlin. Perhaps the time has now come to reduce the papers to more manageable proportions and to reduce the frequency of the congresses since the method is now a proven one and new "discoveries" are getting rarer.

This volume is a useful one particularly in that it records other viewpoints, mainly continental ones, on many aspects of prestressing and it should be on the shelves of anyone interested in the subject of prestressed concrete.

Recherches sur quelques propriétés de certains hypergols. By J. FRANCON. Publications Scientifiques et Techniques du Ministère de l'Air, No. N.T.66. Service de Documentation et d'Information Technique de l'Aeronautique, Magasin C.T.O., 2, Avenue de la Porte-d'Issy, Paris (15e). Price Fr.650.

HYPERGOLS are defined as self-reacting mixtures of liquids which burn within 20 and 40 milliseconds. They must give adequate thrust and their characteristics (speed of combustion, storage properties, viscosity) must not appreciably vary over a range of −20 deg. to +20 deg. Cent. The author presents his researches in this field, using high-strength nitric acid in combination with seven fuels (benzene, white phosphorus, terebenthine, aniline, petrol, fuel oil and white phosphorus solution).

Elektrische Antriebe von Werkzeugmaschinen. By DR. H. VON STENGEL. No. 4 of the TR Special Series. Verlag "Technische Rundschau" Hallwag, Nordring 4, Berne (Switzerland). Price S.Fr.4.80.

THE present issue, No. 4 of the T.R. Special Series, surveys the field of electric drives for machine tools from the viewpoint of the designer, with the object not only of enabling new designs to be based on sound foundations, but also to furnish information for increasing the efficiency of existing machines by modernising their drives. The book falls into four main sections : choice of drive, design (three-phase and d.c. motors, variable speeds, gearboxes), control of machine tools (including programme control and copying), and examples of actual designs.

Books Received

Aids to Workshop Practice. By C. T. Bower. Odhams Press, Ltd., 96, Long Acre, London, W.C.2. Price 18s.

Network Synthesis. Vol. I. By D. F. Tuttle, Jr. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 188s.

Elementary Engineering Science. Fourth Edition. By A. Morley and E. Hughes. Longmans, Green and Co., Ltd., 6 and 7, Clifford Street, London, W.1. Price 11s. 6d.

Prestressed Concrete. By P. B. Morice and E. H. Cooley. Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 57s. 6d.

The Exterior Ballistics of Rockets. By L. Davis, J. W. Follin and L. Blitzer. D. Van Nostrand Company, Ltd., 358, Kensington High Street, London, W.14. Price 64s.

Gas Dynamics. By A. B. Cambel and B. H. Jennings. McGraw-Hill Publishing Company, Ltd., McGraw-Hill House, 95, Farringdon Street, London, E.C.4. Price 85s. 6d.

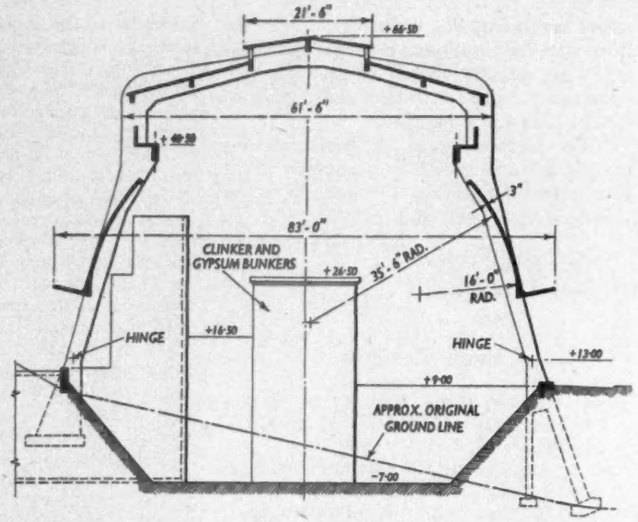
Proceedings of the International Conference on Fatigue of Metals, 1956. Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W.1. Price 90s.

A Manual of Time and Motion Study. Fifth edition. By John W. Hendry. Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 21s.

Handbook of Layout and Dimensioning for Production. By Hyman M. Katz. The Macmillan Company, New York, 10, South Audley Street, London, W.1. Price 87s. 6d.

Reinforced Concrete Structure for Bulk Storage

Economical bulk storage has been achieved in the building described here by excavating a pit, and enclosing the space which would be taken up by granular material deposited in the pit and heaped above it; this shape is modified by provision of an overhead crane. The building is portal-framed and is of cast-in-situ reinforced concrete of an interesting design, as shown on the right.



AT the Saltram cement works in Plymouth, a reinforced concrete structure giving bulk storage for clinker and gypsum has recently been erected. The appearance of the structure was considered important, and the design aimed at architectural appeal combined with economy in relation to the storage capacity available inside it. A sloping site has been utilised in an original manner to achieve this second aim, by forming one side of the building with an existing earthen bank and "making up" the other sides. The main structure has no load-bearing retaining walls, but its capacity is large because of the pit between the feet of the portals; this is clearly shown in the cross sectional drawing. The shape of the building was derived from considering the shape of a heap of material deposited in the pit, and hence the minimum covering needed to protect it from the weather. Two further needs were for lorry access, and for an overhead crane.

The structure itself is of cast-in-situ reinforced concrete and consists of eight pinned portal frames carrying concrete secondary beams and roof, crane beams for the overhead travelling crane, and side walls formed as thin shells with cantilevered canopies, in the manner shown in the drawing. The curvature of these shells imparts sufficient stiffness for them to give a degree of longitudinal stability to the series of portal frames.

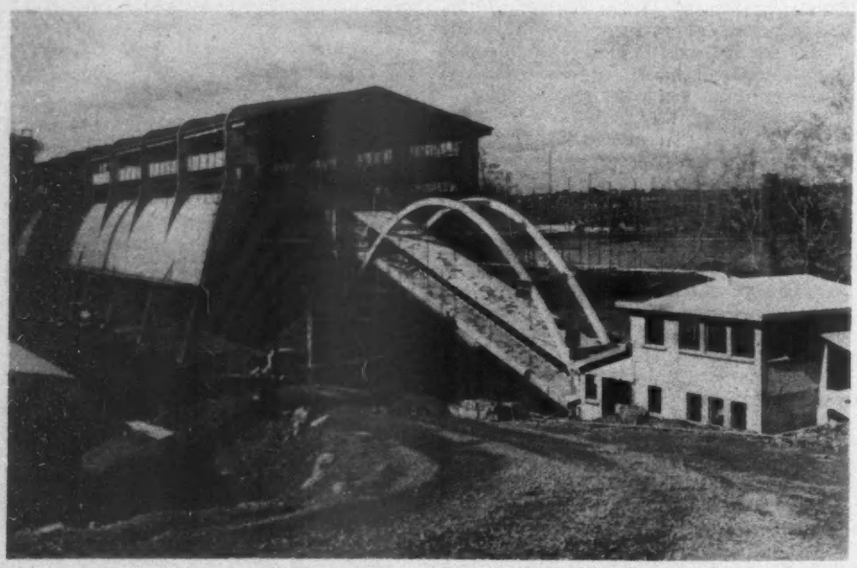
The frames are at 32ft centres, and the overall dimensions of the structure are 240ft by 76ft. The payload of the crane is 7 tons, the clear span between the crane beams being 49ft and the span of the portal frame at this level 53ft. The inclined leg of each portal frame is 14in by 30in in section, reinforced, top and bottom, with two $1\frac{1}{8}$in and one $\frac{1}{2}$in bars, while the vertical section incorporating the crane beam has a section of 14in by 36in reinforced with five $1\frac{1}{8}$in, two $\frac{7}{8}$in and two $\frac{1}{2}$in bars in the tension side and two $1\frac{1}{8}$in and one $\frac{7}{8}$in bars as compression steel. The section at roof level varies in depth from 4ft 5in to 3ft 6in at the centre line; the top reinforcement at the latter point is two $1\frac{1}{8}$in and one $\frac{7}{8}$in and bottom reinforcement is five $1\frac{1}{8}$in bars; $\frac{3}{8}$in stirrups are at 6in centres. The crane beam incorporates a walkway and parapet.

The hinges at the feet of the portals are formed by simply crossing the reinforcement at the centre of the leg, and reducing the cross sectional area from 14in by 27in to 14in by 12in. The drawing also shows the extent of the footings built to carry the portals below hinge level. As a measure of economy, both vertical and inclined footings have been separately constructed under the legs on one side of the building. A continuous beam at ground level ties the feet of the portals together. There are two expansion joints across the building, and the roof has the raised ridge section shown in the drawing only in the central length between these joints.

The divisions into small bunkers as indicated in the drawing occur at the end bay. There is a conveyor tunnel to the cement mill leading from the clinker and gypsum bunkers, and a discharge conveyor from the kiln comes into the building on the left-hand side in the adjacent bay. Three raw materials bunkers are also built right across the building for a length of approximately half a bay, close to the other end. Here, a conveyor system feeds the storage building from adjacent screening and crushing houses. The conveyors are carried on reinforced concrete arches, which are shown at an advanced stage of construction in the illustration herewith.

Each of the two arches are parabolic, but with the springings at different levels. They span 88ft 9in, and are 16in by 9in in cross section. Each arch is "fixed," the abutments being the storage building at one end and the screen house at the other. The conveyor floor slab, which is 7ft 6in wide and 6in thick and sloped at 1 in $4\frac{1}{2}$, is suspended from the arches by $1\frac{1}{4}$in diameter mild steel hanger rods which are attached to the slab at 12ft intervals on each side through upstand edge beams of 17in by 6in section. The slab is free at both ends with locating dowels to prevent lateral movement. Another slab, 4in thick and supported by the hanger rods, is positioned 7ft 6in above the conveyor slab to give protection against the weather. This slab is monolithic with the arches, but is free at each end.

The consulting engineer for the design of this storage building at Plymouth was Mr. H. Spannring. Detail design and actual construction were carried out by Richard Costain, Ltd.



The storage building is shown here at an advanced stage of construction, with the arches and slabs for the conveyors from the screen house in the foreground

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V.H.F. AUTOMATIC DIRECTION FINDING EQUIPMENT.—A low-priced v.h.f. automatic direction-finding equipment has been developed by Ekco Electronics, Ltd., Southend-on-Sea, Essex. The new "CE178" equipment is a v.h.f. cathode-ray direction finder giving automatic display of the sensed bearing of transmissions on any one selected frequency in the 118 to 132 Mc/s band. The low cost is obtained by using a rotating aerial, instead of a static aerial incorporating an expensive goniometer and more elaborate associated equipment. We learn that a prototype of this direction finder has been installed at Southend Municipal Airport for the past twelve months and has been in constant operational use for over 6000 hours, passing some 50,000 bearings to aircraft.

Institution of Naval Architects in France

No. II—(*Continued from page* 102, *July* 18)

SOME PROBLEMS IN THE CONSTRUCTION OF WARSHIPS TO-DAY

(P. GISSEROT)

MONSIEUR A. Lafont: I want to speak in particular of the problems of the navy, which serves as a wonderful test bed for the merchant navy.

I emphasise the parallel problems of stability, volume and superstructure mentioned in this paper. The designer of passenger ships faces analagous problems which have become more acute than twenty-five years ago, whereas the warship constructor had already been studying stability after flooding.

The regulation of 1948 on stability after flooding and the acceptable angle of heel of passenger ships has forced the constructor to compromise between good stability, involving extra costs in the design of the ship form, propulsive power and the rolling of the ship —and a strictly measured stability.

Nuclear propulsion will no doubt be in use a few years hence, and this will give the naval architect some satisfaction, in regard to stability, since the constant weight will allow the displacement to be pre-determined.

Mr. A. J. Merrington : Monsieur Gisserot has brought before us some realistic, valuable and practical factors affecting the construction of modern warships. Whilst the general space problem has always been with us, it is the problem of space in relation to the manning of the ships which is becoming so acute to-day. A number of factors have brought about this state of affairs. It is suggested that our objectives should include the following : (*a*) to control complements of officers and men of ships and if possible to reduce them ; (*b*) to improve living conditions without further increasing space, weight and cost ; (*c*) to improve and simplify ship maintenance generally.

We have endeavoured to achieve this end in H.M. ships. In existing ships, to obtain reasonable accommodation standards in peace, a series of investigations have been made and the peace complement is now being matched to the accommodation available in various ships. As a first step, this is a logical, if rather simple, way of approaching the accommodation problem where the space in the ship is already fixed. In due course, work study investigations should match the numbers more closely to the ships' tasks.

In new designs it is estimated that the space and weight required per man for accommodation, including all services for eating, sleeping, heads, bathrooms, water provision, &c., is of the order of 30 square feet of deck space and about 1 ton weight. To provide this space and carry this weight at the required speed and endurance involves hull machinery and fuel, the combined effect of which on displacement is several times the actual load of 1 ton per man carried. The rough overall cost per ship/ton might be of the order of £1000.

A realistic assessment of the complement is necessary in the early stages of a design, and the pruning process should be pressed as hard as possible. Nowadays the size of the complement is probably the final determining factor in ship size.

In recent years the Admiralty has investigated the possible application of modern industrial work study methods to the functioning of warships. Work study investigations in existing ships should reduce complements through better organisation and output. A Head of Naval Work Study has been appointed in the Admiralty and a Naval Work Study School is starting courses for officers and ratings shortly.

To improve the maintenance output of the crews and cut down the maintenance load in ships and thus make reductions in complements possible, specific, concerted and vigorous action has been taken recently. For example : (*a*) adequate numbers of tank cleaning vessels have been provided to clean ships' fuel tanks mechanically instead of by hand ; (*b*) provision of mechanical equipment, e.g., vacuum cleaners, floor polishers, paint rollers and mechanical scalers ; (*c*) fitting plastics linings and other treatments for bathrooms to reduce maintenance ; (*d*) built-in galley equipment, lining of bulkheads and deckheads, the use of built-in kit lockers, &c. ; (*e*) more use of galvanised or non-corrosive fittings and a continuous search for new or improved materials and techniques, e.g., paints, floor coverings, &c. ; (*f*) the introduction of planned maintenance with maintenance schedules in a substantial part of the Fleet.

All these factors have such a substantial effect on the design and subsequent operation of the ship that the naval constructor should give full encouragement to their development and make his contribution to them.

The second paper presented on Tuesday, July 1, was read, in the absence of author, by Mr. J. A. Milne, and was :

THE BRITISH SHIPBUILDING RESEARCH ASSOCIATION—PROGRESS SINCE 1950

By S. LIVINGSTON SMITH, C.B.E. D.Sc.(Eng.) (*Vice-President*)

SYNOPSIS

The paper reviews the development and research progress of the British Shipbuilding Research Association since 1950. It is in two main sections. The first deals with a number of items of a general nature ; the functions of the Association, its organisation and progress, and the additional experimental facilities that have been established. It emphasises that ship research is directed of necessity to the improvement of ships and acknowledges the work of other organisations which conduct ship research. By December 31 last, 227 research reports had been issued to members and the paper indicates the means used to strengthen and maintain the ties between the Association and its members. The interest displayed by British shipowners is mentioned and it is reported that they have the opportunity of joining the Association. Finally this section refers to the growth of similar organisations in other countries and the manner in which B.S.R.A. has been concerned with nuclear developments. In the second part of the paper is indicated the progress on the various items on the Research Programme under the main sections —hydrodynamics, ships' structures, ships' machinery, performance and vibration. The conclusion is stated that the Association has now developed to the point where the results of its work have made a very substantial contribution to the technical development of the merchant shipbuilding industry in the United Kingdom.

DISCUSSION

Monsieur Jean Dieudonné : Dr. Livingston Smith has spoken of the measurements made in the course of static trials of the bending of ships. We have tried to use this method in France, but the results obtained have been deceptive. The change of the load in a petrol tanker is a slow operation ; and since the results are taken at different times, secondary phenomena have time to vary. We have proved, for example, during tests at St. Nazaire, that a slight breeze is sufficient to modify thermal conditions, and to give a simultaneous deviation on all the extensometers ; the measurements, therefore, have to be taken at night when temperatures are the same during successive measurements. This leads us to prefer measurements made when the load can be applied rapidly. In this category is the launching of a ship, which gives very interesting results but which has the inconvenience in general that the hull is unfinished.

Another method which has given excellent results is to make tests at sea. In the course of trials made under good conditions, when the sea is fairly calm, it is shown, by the simultaneous movement of the extensometers, that the readings are consistent ; one can by this means find the relative values of the forces in the different elements of the structure. We do not have a direct measurement of the bending moment, but this can be found easily when one knows the magnitude of the forces in the different elements of the same section. We have found that this means of study is more rapid and more precise than the static trial obtained by modification of load.

Sir Harold E. Yarrow, Bt. : The review presented in the paper of the progress of the Association since 1950 demonstrates that British shipbuilders and marine engineers are not lagging behind other countries in keeping well abreast of the times in the various aspects of research.

The reference in the paper to nuclear energy shows that the B.S.R.A. is actively engaged in this revolutionary means of propulsion. The British Admiralty is fully alive to this matter and some years ago formed a special department, which is now under the direction of Rear-Admiral G. A. M. Wilson, to study the possibilities of adopting nuclear energy for the propulsion of ships for the Royal Navy and for merchant ships such as oil tankers.

Over ten years ago Yarrow and Co., Ltd., formed a research and development department to investigate, in conjunction with the Admiralty, the most efficient type of machinery for future naval construction. Amongst other important fields of research this department, known as the Yarrow-Admiralty Research Department (YARD), is now engaged in the problems of applying nuclear energy to naval and merchant ships and is co-operating with the Atomic Energy Authority. Not only does the investigation cover the various types of reactors that may be suitable for ship propulsion, but also many other problems that are only met at sea, for instance, weight and space are of considerable importance, and there is the major problem of providing adequate safeguards against marine hazards. There is also the question as to when it is to be a commercial proposition for merchant ships, for shipowners can hardly be expected to adopt a new method of propulsion unless it is to be a paying proposition.

The British Government is interested in this development, and the problem of the application of nuclear energy for ship propulsion is being actively investigated.

Sir Victor G. Shepheard : It is difficult to realise that the B.S.R.A. was incorporated as recently as 1944. In spite of its relatively short life, it has already a record of achievement which has earned for it a high reputation in shipbuilding circles throughout the world. Everyone who has contributed to its work is to be congratulated, but a great deal of the credit must go to Dr. Livingston Smith, the Director of Research. Although

the Association is concerned essentially with research into merchant shipbuilding problems, its work is nevertheless of great interest and benefit to those engaged in warship design. In fact there is the closest possible co-operation between B.S.R.A. and the Admiralty. The Admiralty is well represented on the the B.S.R.A. Research Board and Technical Committees and makes available to the Association and to the shipbuilding industry the results of Admiralty researches so far as security considerations permit. One great advantage resulting from this collaboration and free interchange of information is that it avoids the duplication or overlapping of investigations.

The most interesting section of the paper is that which deals with ship performance. The careful analysis of measured mile trials and the correlation of the results with those obtained in model tests is essential if designers are to be provided with reliable design data. I am glad that the importance of this work is being appreciated by some shipowners and I hope others will make offers of co-operation in measured mile trials and also in the provision of reliable service performance data.

The tests to ascertain the changes in the performance of ships during their lifetime are also of the greatest value, and I hope that shipowners will continue their co-operation in this work. It would be interesting if the tests could be extended to ascertain the effects on performance of different treatments of the shell plating during docking—for example, of how the normal treatment of scraping and re-coating compares with the more thorough cleaning of the plating down to bare steel by grit-blasting before re-coating.

I am pleased that the research programme of B.S.R.A. includes investigations into the best ship forms for seaworthiness. From our work in the British Admiralty, aimed at improving the sea-keeping qualities of frigate and destroyer types, I am sure this investigation should point the way to more efficient merchant ship performances under average and bad weather conditions. I realise that up to now it has not been possible for the B.S.R.A. to sponsor such an investigation because of the lack of the necessary facilities for model sea-keeping experiments. This shortcoming, however, will be made good when the new towing tank and manœuvring tank for the Ship Division of the N.P.L. come into operation.

I am pleased that the research programme of the Association does not include the formulation of a newer and better skin friction line. I feel sure that most ship designers, like myself, have become weary of the long academic discussions of the merits and demerits of particular formulae, especially as the small differences between them are swamped by the effects of the other assumptions which have to be made in estimating ship shaft horsepower from model effective horsepower. Now that the I.T.T.C. has recommended a formula for international use, I hope that the skin friction line controversy will be given the long holiday it so well deserves.

Monsieur P. Blanc : The programme of research of the B.S.R.A. constitutes a complete encyclopædia of all the great questions which preoccupy the technicians of naval construction. I have been impressed by the collaboration which exists between the B.S.R.A. and all the British organisations which pursue research into naval architecture, and shipbuilders. The author has stressed the fruitfulness of the liaison between the B.S.R.A. and Lloyd's Register of Shipping, and I am pleased to state that this spirit of collaboration also exists between the Bureau Veritas and the Institut de Recherche de la Construction Navale.

If there was a time when the classification societies could promulgate their rules from an " ivory tower," it is no longer so, for the speed of progress is such that experiment can hardly keep up with practice. One has to be prepared to construct tankers of 100,000 tons deadweight before having seen those of 50,000 tons in service. The classification societies are now obliged to tighten their specifications to the minimum compatible with safety. This can no longer be done simply by using results obtained in service ; they have to use results obtained in the laboratories by the research organisations.

Conversely, the classification societies can be of great service to the research associations by making available records of ships in service, and this reciprocal collaboration constitutes the best guarantee of the efficacy of work in the common interest of the industry.

Lieut.-Colonel T. Eustace Smith : I think it is necessary that we should from time to time take stock of what such an association is doing and make certain that the work is not only necessary, but that the money, chiefly provided by the industry, is being well spent.

From the paper we can see that the work of the Association is decided on by a research board which is composed of the leading experts in the shipbuilding, ship-repairing and ship-owning industries, and a glance at the list of subjects under examination, given in the appendix to the paper, shows not only how widespread and comprehensive are the subjects, but how very practical so many of them are.

Again, in the carrying out of the experiments, industry itself is called on to do much of the work and shipowners to provide facilities for the confirmation of the data. This not only enables the cost to be spread, but brings more people into touch with the Association and so teaches them to appreciate the work that is being done.

Monsieur M. Jourdain : I should like to draw attention to three of the subjects mentioned by the author. The first concerns the constraints on a ship due to swells. The author has shown that, for the five ships which were used, good correlation was obtained between the constraints and the force and direction of the wind. We have made trials on only two ships, of which one met bad weather. It seemed to us that the correlation was better with the hollow of the wave than with the force of the wind whenever the wave direction was not that of the wind. It would be interesting to know, from the experience of the B.S.R.A., whether this case is normal or exceptional.

The second subject is that of the torsionmeter ; I do not know the details of the ultrasonic technique studied by B.S.R.A., but in principle there are two objections.

On the one hand, it has been pointed out (by Veyssiere, A.T.M.A., 1933) that the modulus of elasticity deduced from dynamic methods has been found to be less than that found statically ; we have had tests of Young's modulus and Coulomb's modulus carried out at two different laboratories on a sample taken from the same shaft. The first laboratory used a static method, the second a dynamic method, using vibrations of sonic frequency. If the measurements of Young's modulus did not confirm Veyssiere's results, for Coulomb's modulus the static method gave normal values, whereas those obtained dynamically were at least 4·5 per cent lower.

On the other hand, the static measurement of a shaft carrying a torsionmeter is not only a determination of the Coulomb modulus of the shaft, but also a method of measuring the couple by an exact balance method, eliminating instrumental errors We find that the results so obtained differ only by 1 per cent from those deduced geometrically.

Finally, the third subject is that of trials on the hull, and particularly of the correction for the effect of the wind. One can calculate from model data, wind tunnel test to a reasonable approximation, the effect of a wind of known force and direction. In general, however, wind is accompanied by a more or less rough sea ; as well as the direct resistance of the hull, the steering also has to be constantly altered, so that the ship follows a sinusoidal course, and these two factors give an extra resistance. All authors agree that effects are unfavourable if the wind is strong ; if it is moderate it seems that the effect varies with the type of ship, but when conditions are favourable the effects are much lower than those calculated for wind alone.

In conclusion, we consider that as it is impossible to evaluate the effect of the sea, the correction for the effect of the wind alone is more harmful than useful, and we admit that the performances represent the best calculable approximation to those for calm weather.

Mr. John Brown: The Research Association is now a recognised feature of the shipbuilding industry in Great Britain. It has the full support of that industry and many of us in the industry have been grateful for guidance and help on problems for which it would have been difficult to obtain a solution without its comprehensive resources.

In the paper it is stated that a major factor in the Association's success has been the working of the committee system, and I endorse this from personal experience in the Ships' Structures Committee. The direct contact and the discussions around the committee table between the representatives of the member firms and the specialists from outside the industry are particularly valuable. Dr. Livingston Smith mentions the benefits that are secured by students in the universities and colleges in which some of the research work is being carried out. I submit that an even more important benefit is gained by the professors and staffs of these colleges in the committee discussions. They are brought to discover that, however involved and highly theoretical the method they may require to use in the solution of a problem, they must ultimately convey that solution and something of the method to the practising technician in terms that he can understand. Equally the industry's representatives have found that the use of more advanced techniques by specialists in the academic field has led to a much fuller understanding of problems which their own more elementary approach did not provide.

A notable example of this has occurred in the investigation, under the auspices of the Ships' Structures Committee, of the reaction between a box girder and a superstructure mounted on it. A judicious mixture of experiment and theory has carried our understanding of this well beyond the results obtained by the old " beam theory " approach. It was my privilege to conduct two of the leading structural specialists on the committee over a large ship and to acquaint them for the first time with practical shipbuilding. I think they would admit the benefits they derived. I would equally concede that without their thorough development of the research work our knowledge of this

particular problem would still be elementary.

It is one of the great advantages of the Association that it is able to engage the interest and employ the skill of such a wide range of specialists in different fields for the benefit of its members, to an extent that would be beyond the capacity of even the largest individual firms.

Dr. Smith has emphasised the value of the co-operation that exists between the B.S.R.A. and the Classification Society, and I am sure that Lloyd's Register would admit that this is a two-way traffic. While the Society has always had the co-operation of the industry by the participation of its members in Lloyd's technical committees, the Research Association has extended the contacts to a wider and more fundamental field and afforded to Lloyd's the critical and constructive comments, not only of the industry, but of the outside specialists I have mentioned.

The enrolment of shipowners as Associate Members of the B.S.R.A. is undoubtedly a far-seeing step in completing its organisation, as their representation in the working committees can provide the very necessary contribution of the views of the ultimate beneficiaries of the Association's work which will ensure its practical and useful nature.

Mr. J. M. Murray : In the twelve years during which B.S.R.A. has been in existence it has done much to clarify ideas on the matters in which the naval architect is interested, and while the first half of that period may be considered as being preparatory, the second part, which is dealt with in this paper, has produced some very important results. From the point of view of the structure of the ship, I attach great importance to the work which is being done to record strains which ships experience in service. Before the B.S.R.A. undertook this work the naval architect had to rely on a very limited amount of data. There was little beyond the results gathered from sea trials of the " San Francisco " and the " Ocean Vulcan." These results were of great value, but limited to a particular class of ship ; the methodical series of trials which are now being carried out should be of great value to the naval architect.

There are many other points with regard to the structure of ships on which B.S.R.A. has given to the industry and the classification societies much assistance. In particular I would refer to the work done at Glengarnock, with which Lloyd's Register is intimately concerned. This work has resulted in a better knowledge of the structural mechanics of the component parts of a ship being available and has enabled scantlings to be reduced in some instances, though it would be fair to say that the tests have shown that there was little margin for reduction. The tests on the double bottom structure, referred to in the paper, which were carried out by Lloyd's Register under the ægis of B.S.R.A., provided us with a better knowledge of the mechanism of the corrugation of double bottoms and demonstrated the defects of the transverse system of construction as applied to the bottom of a ship which was normally subjected to compressive forces. No doubt those tests had much influence in inducing shipbuilders and owners to fit the more logical systems of longitudinal framing.

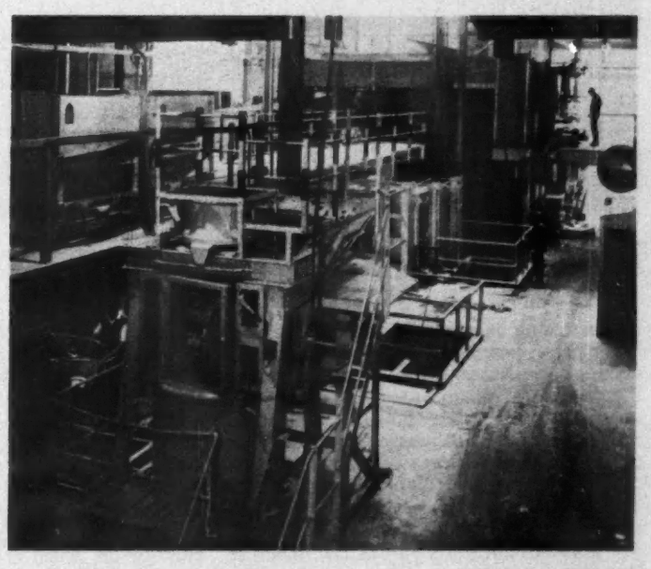
Mr. R. N. Newton : Dr. Livingston Smith refers to the difficulty of avoiding description of a large number of items constituting the B.S.R.A. research programme—a programme which is as formidable as it is ambitious. I feel that had he described many more of the items listed in the programme it would have enabled the reader more easily to assess not only the relative importance of the various items, but also the effort, time and cost involved in each one.

For instance, in the hydrodynamics section of the programme, now that the resistance and propulsion methodical series have been completed more effort will presumably be made available for such important items as the best form for seaworthiness. An outline of the investigations intended under this heading and the difficulties confronting the investigator would have been very welcome. One of these difficulties is to arrive at acceptable definitions or standards for the many qualities embraced by the term " seaworthiness." I raised this question at the International Towing Tank Conference at Madrid in 1957, and illustrated the point by describing some experiments at Haslar on " wetness," in which the degree of this quality was shown to be largely dependent upon freeboard.

(*To be continued*)

Frit for Vitreous Enamelling

A number of new applications have been developed for vitreous enamel in the engineering industry during recent years and, in particular, increasing use is being made of this form of surface protection for metals exposed to abrasion and high temperatures. To meet the demand for the special high quality frits used in the process, a considerable amount of research and development has been carried out by Ferro Enamels, Ltd. In this article we give some particulars of the production and control methods used at the firm's works, part of the smelting shop of which is shown on the right.



ALTHOUGH vitreous enamel, or porcelain enamel as it is sometimes called, has been used mainly for decorative and probably to a lesser degree for protective purposes in industry for more than half a century, new techniques developed in recent years have widened its applications for metal protection in many fields. Enamels are being increasingly used in engineering to impart resistant surfaces to metals exposed to attack by high temperatures, abrasion, corrosion and chemical substances, They provide what is essentially an integral glass coating formed by fusing pulverised inorganic materials on the base metal. Such coatings, as is generally known, are applied to the metal in liquid form, dried and then fired at temperatures from 660 deg. Cent. and over, and they can now be applied successfully to materials ranging from aluminium to cast iron.

We recently paid a visit to the works of Ferro Enamels, Ltd., at Wombourn, Wolverhampton, one of this country's largest manufacturers of the frit which forms the basis of vitreous enamels. The formulation of this frit and the high quality of the various ingredients are to a very large extent responsible for the properties of the enamel fused on the finished article and its suitability for specified duties. There are more than fifty different materials used in various frit formulations, and these can be sub-divided into four distinct classes : refractories—such as silica and felspar ; fluxes—such as borax, soda ash and cryolite ; opacifiers—such as antimony oxide and titanium oxide; and colouring and bonding materials—such as cobalt oxide, nickel oxide and manganese oxide.

As already mentioned, frits can be formulated to provide suitable vitreous enamels for many purposes and amongst those of interest is the application of high temperature coatings to protect the metal of jet engine afterburners and engine exhaust manifolds. In this connection the flameproof properties of a vitreous enamel, combined with its high thermal emissivity value and thermal shock resistance, have proved of great value in afterburner construction. The standard A.I.D. test for the " Solaramic " enamel coating used in this connection is particularly severe in that a part on which it is applied must withstand heating to 900 deg.

Cent. and plunging directly into cold water fourteen times without failure. The uses of vitreous enamel in chemical plant and processing plant are well known, and it is being increasingly used in buildings where advantage is taken of its corrosion resisting and weathering properties combined with attractive colours when applied to sheet metal. One of the latest developments of interest to builders and architects, which will probably find application in engineering, is the application of enamel to aluminium, which can be either in the form of thin foil for bonding to building board, or on heavier gauge structural metal. It can now also be applied to stainless steel for decorative purposes or at points likely to be subjected to high abrasive wear.

During the past few years a steady programme of development has been followed at the works of Ferro Enamels, Ltd., to meet the increasing demands for frit and promote the closest possible control of the basic materials to ensure quality. If precise control is not rigidly adhered to at all stages and impurities get into the finished product its properties can be seriously impaired. For example, iron or chrome contamination will seriously affect the colour of a covercoat enamel and particular care must be taken to exclude them. For this reason, all incoming raw materials undergo rigorous tests to ensure that they are up to a preset specification.

Raw materials released for processing are stored on an elevated floor at one end of the factory and batched for mixing at one side of this floor. A batch can be made up of from ten to fifteen different materials, each of which is accurately weighed and deposited into the hopper of a mixing machine. A recently installed mixing machine which has proved particularly successful in providing a good homogeneous blend is known as a "Mix-Muller." It consists of a large cylindrical drum in which heavy circular mullers revolve in the materials as they are carried round in the drum. This mixing process has of necessity to be particularly efficient to ensure satisfactory melting in the next stage of the process, owing to the fact that some of the materials in the batch are highly refractory, whilst others fuse easily and others decompose or volatise rapidly. From the mixers the batches of material are transferred by hoppers to either box smelters or a line of a new design of continuous smelters.

At the end of the necessary melting period in the box smelters the molten glass is tapped either directly into a tank of water or quenched by a stream of water as it flows out of the furnace. This sudden quenching shatters the enamel into the small friable particles known as frit. In the new continuous smelters the mixed materials are screw fed from a hopper into the back of a furnace to form a pile. The speed of the feeder is such that this pile is maintained as the temperature in the smelter melts the face of the pile. The smelter is so designed that the exact conditions of the time and temperature cycle required to produce the enamel are fulfilled by the time the molten enamel reaches a tap-hole in the front of the furnace. From this point the constant flow of molten enamel drops down through a pair of water-cooled rollers. The cooling and squeezing effect of the rollers produces a fine ribbon of glass which drops into a breaker from which the enamel emerges in flake form on to a belt conveyor on the floor below. At the end of this conveyor the frit passes into the lower run of a spiral vibrating elevator on which is completed the cooling process. The enamel flake is then passed over an electromagnetic conveyor to remove any possible contamination with tramp iron. The flake is then ready for bagging and it is in this form that it is sold to the enamelling companies.

The next stage of preparation which is usually done in the customer's own plant, is to grind the flake enamel mixed with colouring materials where required. These colour oxides are prepared by firing in special kilns and they are ground into fine powder form in an adjoining section of the plant. The preparation of the enamel by grinding is done in ball mills, either dry or wet, according to the type of enamel.

In our title illustration the trucks of batched material can be seen on the elevated runway leading to the smelters. The quenching pits of the batch smelters can be seen in the centre, and behind these smelters is situated the continuous smelter installation.

The standard range of frits made in this works covers more than 150 types and colours and to ensure consistent quality and positive duplication in the case of repeat orders, laboratory control is exercised in all stages of production. The purity of the ceramic raw materials is, as already mentioned, of particular importance, and to facilitate the analysis of these materials, spectrographic methods of analysis have been developed. This use of spectroscopy has made it possible to eliminate much of the time hitherto required for the chemical analysis of the materials to determine the nature and quantity of impurities in representative samples. In most cases quantitative results are essential, but some problems can be solved by simple qualitative techniques. For this latter type of work the slit of the spectrograph is fitted with a diaphragm enabling several spectra to be photographed in juxtaposition. It has been found possible—even using minute samples—to say within a matter of minutes what elements are presented. We were informed that investigations of methods for accurately determining major constituents in enamels, refractories and raw materials are still in progress, but from results so far obtained it is considered obvious that in the near future chemical methods of analysis will to a large extent be replaced by spectrographic methods.

The production control side of the laboratory in maintaining its continuous check on all stages of frit manufacture, receives samples taken from every smelt, and these samples are subjected to tests for fusion, flow, adherence and colour against standards. The results are then filed for a minimum of twelve months, so that at any time an individual bag of enamel frit or flake, each of which bears a series number, can be related to the control approval test record.

Control laboratory for continuous checking of frit production. Samples are taken of all smelts and subjected to tests for fusion, flow, adherence, colour and reflectance against standard frits to ensure complete uniformity of production

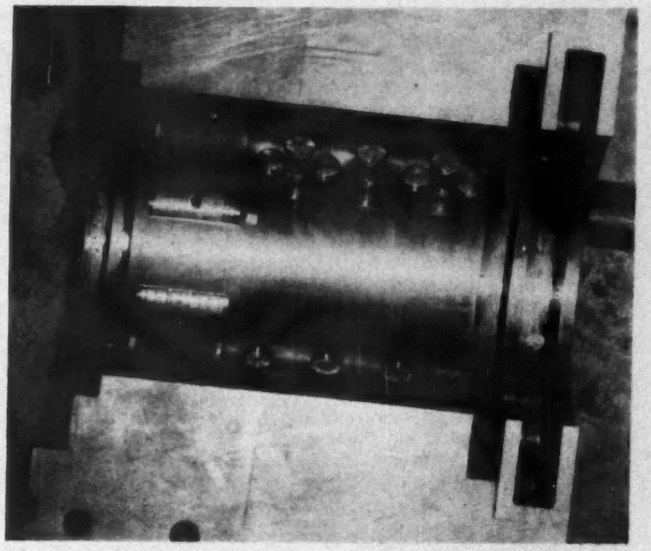
Technical Reports

Selected Abstracts of Atomic Energy Project Unclassified Report Literature in the Field of Radiation Chemistry and Bibliography of the Published Literature: 1st Annual Supplement. Atomic Energy Research Establishment, Harwell, Berkshire. Price 28s.—This is the 1957 supplement to the documents already issued in six "Parts," under the number A.E.R.E. C/R 1575. Separate supplements are not being published for each part, but the comprehensive annual supplements, of which this is the first, will be divided into sections corresponding to those Parts. The whole covers theory, interpretations, water and aqueous inorganic systems, organic compounds, gaseous and solid systems (excluding organic compounds), biochemistry and radiobiology, colloids, corrosion, industrial applications of radiation, &c. Use has been made of the U.S.A.E.C. Abstract Card Service and Nuclear Science Abstracts.

The Wave Drag of Non-lifting Combinations of Thin Wings and "Non-Slender" Bodies. L. M. Sheppard. Reports and Memoranda No. 3076. H.M. Stationery Office. Price 6s. 6d.—The methods of wave-drag estimation known as the area rule and transfer rule are restricted to non-lifting combinations of thin wings and slender bodies. The Lomax-Heaslet multipole method is applicable to configurations with "non-slender" fuselages, represented by an axial distribution of multipoles. However, it is not entirely satisfactory and an alternative multipole method is presented here. This is based upon the assumption, fundamental to the area rule and the transfer rule, that the effect on the wave drag of the interference velocity potential, due to the interaction between the exposed wing and the fuselage, is negligible. An investigation of the validity of this fundamental assumption, based on existing theoretical and experimental results, is given. The application of the multipole method to fuselage design for low combination wave drag is discussed with special reference to an elliptic wing-body combination.

Pametrada Annual Report

We abstract below the Progress Report for Year 1957 of the Parsons and Marine Engineering Turbine Research and Development Association. During the year the high temperature gas turbine was run, the combined bearing and gland for a steam turbine shown here was tried out, and impressive results were obtained from the profile-generating gear grinding machine.



THE progress report for 1957 of the Parsons and Marine Engineering Turbine Research and Development Association has now been issued. It records that the Council decided during the year to make a substantial expenditure of capital to install permanent steam-raising equipment for the testing of merchant vessel machinery—since over 500,000 s.h.p. of Pametrada machinery was completed during the year, it is hoped that finance to utilise these facilities should be forthcoming. A panel of Technical Committee "A" (Steam Turbines) was formed to initiate the design of a prototype plant for advanced steam conditions which may be developed on the new facility : the power is to be 22,000 s.h.p. and the conditions 800 lb per square inch gauge and 1035 deg. Fah. What now appears to be normal turnover of staff took place during 1957, the report states ; the library and information service maintained satisfactory progress in introducing the universal decimal classification, only the first 1000 reports and the books being outstanding. The reproduction of photographs in the Association's reports has been improved by the adoption of the off-set lithography process.

Steam Turbines

Vessels delivered during 1957 with Pametrada engines included the tankers "British Valour" and "British Courage," each with a maximum of 25,000 h.p. on a single screw. The ships will steam in peacetime service at the normal 14,000 h.p., with an overload capacity of 15,000 h.p. A large by-pass is incorporated which admits live steam after the eighth stage of the h.p. turbine, giving a service power of 22,500 h.p. with a further 10 per cent overload margin. The normal condenser vacuum of 28½in falls to 27⅝in at maximum overload in sea-water at 75 deg. Fah. ; this 78 per cent increase of power of the standard turbine set will, the report states, certainly be safe if used only after the machinery has been run in.

Full-scale trials included the completion of tests on the Hawthorn Leslie double-casing h.p. turbine, a nozzle plate modified to eliminate leakage being tested with different axial clearances ; the use of radial shrouding of the Curtis stage was also tried.

Modifications to the Curtis wheel that formed the steam brake for "Pamela" continued ; a ball race instead of a Michel thrust bearing is proposed, to minimise friction losses. To measure the power losses it is intended to equip the plant for motoring through a torquemeter. A dynamometer for this scheme would, it was hoped, arrive early in 1958.

The small condenser allowing observation of condensation on the tubes was completed ; a technique of introducing the promoter of dropwise condensation into the steam supply line was developed successfully. An increase of 30 per cent in the overall heat transfer coefficient was found in one case ; after interruption of steam supply the promoter appears to recover its efficiency within a few hours. The single-stage air turbine was found to suffer from vibration above 4500 r.p.m. ; after rebalancing, this was cured by replacing the Metastream coupling fitted the year before (see page 644, November 1, 1957) with one incorporating rubber bushes. To enable pitôt traverses to be carried out relative to the rotating blades, a rotating pressure transfer device is being designed ; the results of such traverses would be truly averaged over the inlet flow and directly comparable with two-dimensional cascade results.

Gas Turbines

The design section suffered, in September, the disappointment of the cancellation of the 3000 h.p.—3500 h.p. maximum—gas turbine mentioned in the previous report ; this arose from the cancellation of orders for a number of ships, the diesel machinery ordered for one of them being diverted to take the place of the turbine. The turbine design, which avoided axial joints, had been completely revised to avoid infringement of existing patents, and the fundamental critical speeds of all rotors had been rendered higher than their intended maxima. The estimated fuel consumption had gone down to 0·46 lb per shaft horsepower hour. For this project a method of designing twisted turbine blades for ease of manufacture was evolved, and cascade tests of the root, mean, and tip sections for the h.p. turbine fully justified the method from the aerodynamic standpoint. A new nozzle profile which was designed was shown by cascade tests to have a low loss coefficient and a useful incidence range of at least 80 deg. These nozzles are to be incorporated in a range of turbines for use with free-piston gas generators, using a rotor blade profile specially designed for such applications instead of steam impulse blading ; this is expected to give approximately twice as much power from a turbine of a given size. Because an astern turbine casing cannot be exhausted, a number of schemes for free-piston gasifier turbine installations include reversing hydro-kinetic transmissions. Technical Committee "B" (Gas Turbines) has been instructed to prepare a design, for use with free-piston gasifiers, of radial inward flow turbine that will be reversible ; it is intended to build and test the turbine with the 3500 h.p. marine gas turbine which, it will be recalled, is at present a gas generator, exhausting through an orifice.

The new compressor blading has caused the 3500 h.p. set to operate closer to the stall, and blow-off from the l.p. compressor is now continued until just before design speed is reached. Fouling and corrosion were found to be more severe with "Vanilla" than "Mothball" fuel and subsequent runs were made on the former ; the powder additives used were kaolin, "Aerosil," and "micronised" mica waste, of which the last gave worst results. Stalling of the compressor terminated all the trial runs, having taken place during the washing of compressors which has been found necessary every four hours ; opening of the blow-off valve has been practised, and rendered stall of the h.p. compressor possible. Other approaches to the fouling problem have been considered, and the Research Board has discussed the mechanical cleaning of blading while running. A trial has been made of injecting sand into the gas entering a fouled-up turbine ; this method is deemed promising if practised before fouling becomes excessive.

The liquid-cooled high-temperature gas turbine was completed with the Mk. I rotor and run at gas inlet temperatures of 1250 deg. Fah., 1700 deg. Fah., and 2035 deg. Fah., gaining much useful heat transfer data. (This rig is designed to accept 2200 deg. Fah.) One Mk. II (axial withdrawal) rotor disc has been pressure tested to 6000 lb per square inch and a second is in progress ; the blades are being recessed in Nimonic 80 by spark machining, instead of being cast hollow in Stellite, and closed by welding on the end cap.

The best ceramic blade material remains the Morgan "I.C." previously mentioned, despite tests of various materials, including silicon nitride. The Thermal Syndicate, Ltd., has developed a method of extruding refractory bricks to suit the Pametrada method of mounting them within a flame tube. For the cooled combustion chamber a one-piece refractory liner has been cast.

A further 740 hours heat exchanger development was run during the year, using "Vanilla" with kaolin, "Teepol," and 1 per cent sea-water added as fuel. There has been no appreciable drop in the thermal ratio, so no soot blowing has been performed. Tubes of mild steel and 1 per cent Cr-Mo steel had corroded near the cooler ends and aluminium-sprayed mild steel tubes been only partly protected by the coating ; aluminised mild steel tubes have shown very good resistance to oxidation, being attacked only at gaps in the iron-aluminium alloy layer.

Other Components

The boiler design section has studied a boiler with a furnace pressurised to 3½ atmospheres; cross-flow heat transfer is used throughout in order to attain high heat transfer rates without unduly close tube pitching, so that it is hoped to be able to use residual fuel.

The prototype gear grinding machine made by Craven Brothers (Manchester), Ltd., and illustrated in our abstract of last year's report, has completed over 5,000,000 strokes in rather more than 400 hours' running without deterioration. The elasticity of the temporary test rig prevented repetition of high-speed operation reported last year, but the repeatability after 36 hours' operation was believed to be better than 0·000025in.

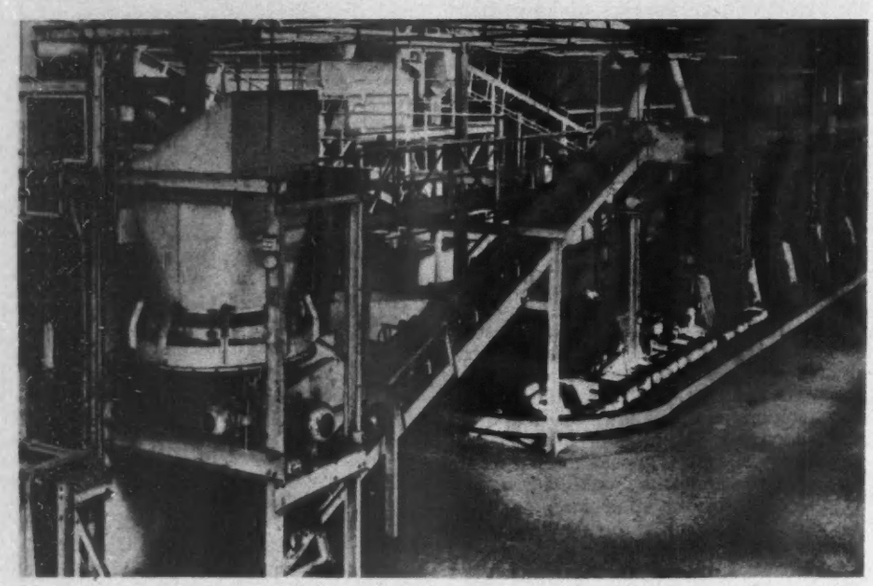
The development of a reversing hydrokinetic transmission for the "Auris" has continued, and a sintered friction material made by the Morgan Crucible Company, Ltd., has been subjected to rubbing tests at the design conditions, dissipating 4·7 h.p. per square inch at 32·6ft per second. The total wear was 0·002in after fifty rubs and 0·0025in after 100; a further sixty-five produced no increase.

The investigation of steam- and water-lubricated bearings led to the design of a combined journal and thrust bearing and gland suitable for a turbine. We illustrate such a bearing, running on steam at 700 lb per square inch, which has replaced the original bearing and gland on an S.G.B. turbine.

Tests of lubricants to inhibit seizing at high temperatures showed that greases containing molybdenum disulphide were the most effective, but that all of nine thread treatments on two material combinations, except phosphating on one, were of some benefit; stud-nut combinations of 1 per cent Cr-Mo-V and ½ per cent Mo tested at 950 deg. Fah. needed treatment no more than En 15 and En 6 at 650 deg. Fah.

Malleable Iron Foundry

Last week we inspected a new foundry for the production of blackheart malleable iron castings which has recently been completed at Halesowen, Birmingham, for Shotton Brothers, Ltd. The foundry building is a spacious one, and the equipment has been designed to reduce heavy manual work to an absolute minimum.



Distribution belt conveying sand from the mill hopper to moulding machine feed hoppers

A NEW foundry for the production of blackheart malleable iron castings has been opened at Halesowen, Birmingham, by Shotton Bros., Ltd., a member of the Birfield group of companies. It occupies about one-sixth of a 10-acre site which the company has acquired, and is intended as the first of a number of similar units, each having a capacity of approximately 80 tons of castings a week. The services and flow of work have been so arranged that a second unit can be built against the north-west wall of the present foundry and the whole operated as a single plant.

The equipment of the new foundry is sited to give a continuous flow of work from the stockyard adjoining the east corner to the dispatch department in the north corner. At the same time, the handling equipment is such that the plant can be used to supplement the facilities at the firm's existing foundry at Oldbury for producing short runs of castings and special castings including pearlitic malleable iron castings.

Three rotary batch melting furnaces are installed, their heats being staggered to provide a continuous supply of molten metal of controlled composition.

Each ingredient of the charge is carefully weighed, batches of raw material being stored in separate pens and their composition checked against the suppliers' stated analysis. Two samples are taken from each melt before it is poured and a rapid chemical analysis carried out on each to determine the carbon, silicon and, if necessary, manganese contents. If the first analysis reveals a discrepancy in the amount of any component, additional metal is added before the second sample is taken. During pouring, samples are taken every fifteen minutes. The chemical analysis of each sample occupies twenty to twenty-five minutes, so that changes in composition are quickly detected, and should the composition of a batch of castings fall outside the desired limits, this can be compensated for by an appropriate adjustment of the annealing treatment.

The melting furnaces each have a capacity of 7 tons and can be tilted to assist charging and slag clearance. They are fired with creosote pitch which is fed to them through a metering pump at a controlled temperature from a heated outside storage tank. Recuperators supply a controlled weight of hot air, and the temperature of the metal when tapped from the furnaces is checked by an optical pyrometer and maintained within ±20 deg. Cent. A test bar is cast from each melt for determination of tensile strength, yield point and elongation to ensure that these conform to British Standard requirements.

The sand plant is fully automatic. Feed hoppers of appropriate sizes store used sand returned from the knock out station, as well as new sand, bonding and carbonaceous materials. Preset electrically-operated timers control the volume of each ingredient fed on to a supply belt and thence into a skip discharging into a reversible chute which feeds one or other of two batch mills. Water additions, obtained from a supply having a standardised flow rate, are controlled by another electrically-operated timer and milling proceeds for a predetermined time interval. The discharge door then opens automatically, delivering sand into a skip hoist which carries it to a distributing hopper. The distribution of sand by the conveyor belt feeding the hoppers over each of the ten moulding machines is the only operation requiring manual control. Push buttons are provided to halt the sequence of operations temporarily if necessary; their use does not upset the timing of the various operations in progress at the time. Part of the sand conveying system is illustrated herewith.

The controls of the sand plant are electrically interlocked to prevent any operation occurring before the next item of plant is ready to receive it. A check timer, set to operate a few seconds after all the feed timers should have cut off, comes into operation if any fails to do so and gives immediate warning. The control panel, on which all the preset timers are placed, is located in the compressor house and is under the direct control of the laboratory staff, who also carry out the standard routine tests on the sand at half-hourly intervals; these include determination of moisture, green strength compression test, shatter test and permeability test.

Core-oils are normally purchased ready-mixed, though special mixes can always be made up to meet particular requirements. After drying, the sand is fed through a pneumatic duct to twin totally enclosed hoppers; these are provided with electrical probes to indicate when they are full. From the measuring hoppers underneath each storage hopper, the sand discharges into the mixing machine and is then fed to the coreblowing machines. A pendulum conveyor carries the green cores to the thermostatically-controlled, oil-fired drying stove, after which they are placed on portable stillages adjacent to the pallet mould conveyor, until required for use.

Turn-over machines incorporating automatic control of the number of jolts are used for moulding. It is intended that, when the foundry is in full production, four machines will be making top half moulds and four bottom halves, leaving two machines available for pattern changing and sampling procedures. The bottom half moulds are placed on the continuously moving pallet mould conveyor, cores are laid on from the gangway side of the conveyor and top half moulds added. The complete moulds then travel round to the casting area adjacent to the furnaces. Molten metal is carried from the furnaces in preheated ladles suspended from an overhead runway and the castings poured.

When the pallet mould conveyor is moving at its normal rate of about 10ft a minute, the moulds take about thirty minutes to travel through the cooling tunnel. The cooling tunnel is completely enclosed so that the fumes can be extracted from it by fans and taken out of the building. On leaving the tunnel, the moulds arrive at the knock out station. This too has been enclosed to prevent dust and fumes spreading through the foundry. The design of the hood and the rate at which air is drawn through it were the subject of much research, as it was necessary to ensure that all the dust and fumes are removed from the working area, while at the same time the maximum amount of sand falls through the vibrating grid on to the belt conveyors which return it to the storage hoppers. On the way, the used sand passes a magnetic separator to remove particles of metal and a rotary screen to take out any lumps of hard sand. Empty moulding boxes are returned to the moulding machines on a gravity roller conveyor. Although only a little sand is sucked into the exhaust hood, a wet dust extractor is installed to prevent this being discharged into the atmosphere.

At the knock out station, castings are loaded into pallet trucks, and runners, risers and feeder heads broken off by hand and returned to the charging platform for remelting. The castings go forward to a rotary shot blast table for cleaning and are then placed on a turntable which serves both as an inspection bench and as a temporary storage rack. Inspected castings are moved in boxes on a roller conveyor for packing into sealed white iron containers mounted on rail trucks which protect them from the action of the furnace gases during their passage through the annealing furnace. A loaded truck is pushed into one end of the furnace every eight hours and a truckload of annealed castings is simultaneously ejected from the other end. This procedure is operated continuously, a sufficient stock of castings being built up during the week to keep it going over the week-end. The furnace is oil-fired, having both the oil and air supplies controlled by electrically operated valves. The temperatures in each of four zones of the furnace, which can be selected at will, can be controlled to within ± 5 deg. Fah. to enable the annealing cycle for any particular truckload of castings to be adjusted to meet special requirements.

After annealing, the castings are placed in boxes and moved on roller conveyors to grinders for removal of gates and flashings ; each grinder is connected to a wet dust extraction system. Pressing, hand straightening and gauging are concentrated in an area to which all castings flow after grinding, and a second rotary shot blast table is provided for treating annealed castings. Every casting is given a final visual inspection before dispatch.

Two-Colour Offset Litho Press

A RANGE of "Master" high-speed two-colour offset litho presses has been introduced recently by George Mann and Co., Ltd., the purpose of the development being to increase printing speed and simplify running operations. There are four models in the range, the maximum sheet sizes and speeds being 38in by 25½in at 7500 per hour ; 42½in by 30½in at 7000 per hour ; 50in by 36½in at 6500 per hour ; and 55in by 38in at 6000 per hour. Our illustration is of the model for a paper size of 38in by 25½in.

The Mann "Master" two-colour offset litho press has been designed to print at high speed. Careful thought has been given to the cylinder layout and the well-known "V" formation has been retained which enables two colours to be printed whilst the sheet is held by one set of grippers on one cylinder; this eliminates any possible register error which could arise by transferring from one cylinder to another. In comparison with the two-colour press having one unit above the other, the operator has less movement to make since both units are on the same level. A further advantage is that dirt cannot fall on to the second unit when washing the first.

"Master" press for paper size 38in by 25½in

The automatic feeder embodies the latest improvements so that the efficient high-speed feeding of either paper or board can be continuously carried on with the minimum make-ready or other adjustments when changing from one stock to another. It is worthy of note that the feeder has actually been tested feeding sheets at 9000 per hour during proving tests. The registering device is incorporated in a complete pre-register feed unit. The sheets are fed in stream formation down the layboard and the leading edge of the foremost sheet is guided under smoothers attached to primary or pre-front-lays which guide the sheet forward, correcting any errors in alignment and at the same time reducing the speed at which the sheet arrives at the main front-lay so that it does not buckle on impact, as would normally occur with a high-speed cycle.

The slow-down-lays are lifted on their return stroke so that the smoothers attached to them are well clear of the feed-plate and allow ample access for the entry under the smoothers of the oncoming sheet. At this stage the smoothers are lifting the preceding sheet which is leaving the feed-plate. It has not been found necessary to introduce any suction device to assist the sheets to enter under the slow-down smoothers, it having been found preferable to operate under purely mechanical control at this stage in the movement of the machine. However, to assist control when required, a blowing tube has been fitted over the stream of sheets on the lay-board so that air is blown along the top sheet entering the slow-down, thus aiding separation from the preceding sheet and ensuring that it is flat down at the leading edge as the smoothers ride over it.

As the sheet arrives at the main front-lays it actuates the automatic check fingers which trip the press if the sheet is late. The trip mechanism separates the cylinders, stops the feeder, checks the ink and water and prevents the swing-arm grippers closing at the feed-plate position. The swing-arm mechanism has a positive cam operation in both directions of swing, thus eliminating reliance on springs to return the swing-arm to the feed-plate position. The swing-arm transfers the sheet to the first of two feed-cylinders which in turn transfer the sheet to the impression cylinder.

The object of using two feed-cylinders is to provide for the use of a swing-arm which operates above the feed-plate, thus giving a flatter trajectory to the sheet ; a big advantage, especially when working on heavy card. A further advantage is that the sheet is completely visible during feeding. Make-ready time is reduced by a hand-wheel which adjusts the height of the feed-plate for variation in stock thickness.

A hand-wheel registered against a calibrated setting dial adjusts the printing pressure and a micro-adjustment is provided for blanket-to-plate pressure. By means of a damping unit a fine feed of water can be taken and at the same time can be rolled out and then distributed over the surface of the plate. The water feed is controlled by a drive to the fountain roller, with finger-tip control to vary the feed between minimum and maximum.

The inking unit, of pyramid design, has an additional link to bring the ink down both sides of the pyramid, thus permitting heavier "solids" to be obtained. When the press is tripped the inking plate rollers lift in pairs in the gap and also fall in the gap on restarting to print, so that the cylinders always obtain a complete impression and the whole sheet is printed. An improved mechanism, operating on the toggle principle, retracts the ink-knife for cleaning without disturbing the knife setting. The delivery mechanism has been designed so that the weight of the gripper bars is supported on ball-races running in an independent track from the chain track and thus obviating twist and side strain. All models are equipped with a suction roller and over-pile sheet blower. The suction roller is arranged so that, when not printing, by the turn of a handle a blast of air can be forced through the roller to blow out any dust and fluff.

SHORTER REPORTS

Essex Firm's Centenary

AMONG the centenaries of engineering firms which are being celebrated this year is that of Christy and Norris, Ltd., Chelmsford, Essex. The history of the firm and the record of its development are set out succinctly in a brochure which has just been published. The founder of the firm, Fell Christy, was the youngest son of a Chelmsford farmer; he is described as an "engineer by intuition" who was an indentured apprentice with a Wickham Market millwright. Fell Christy had not long completed his apprenticeship before determining to set up in business on his own account. Accordingly, in the summer of 1858, he bought a house in Broomfield Road, Chelmsford, and on a plot of land adjoining it there was built the Broomfield Road Iron Works. In his early days, Christy's work was concentrated mainly upon the building and servicing of wind and water mills in this country and in Ireland.

Subsequently, Christy developed the manufacture of grain and similar grinding machinery and of brickyard equipment. In addition, like many another engineer of his day, he built his own steam motor car! He was joined in 1880 by James Alfred Norris, whose main interest at the time was the construction of agricultural steam engines and boilers. Grinding machinery and disintegrators for the production of cattle feeding stuffs and fertilisers soon became the firm's principal manufactures. Machinery of this kind for agriculture and the chemical, food and plastics industries constitutes the major part of the firm's present activity.

There is reference in the centenary brochure to the company's endeavours to keep pace with the developments in personnel relationships and the provision of works amenities. The founder of the firm did not overlook these matters! In the brochure there is reproduced the "Rules and Regulations" which came into operation at the Broomfield Road Iron Works in January, 1899. All "workmen and lads" then in the employ of the firm and all "new workmen and lads" were expected to read the rules and were "considered to have accepted and bound themselves to obey the same." One of these rules reads: "The work hours are from 6 a.m. to 5.30 p.m., excepting Saturdays when it will be 6 a.m. to 12 noon, the mealtimes being from 8 to 8.45 a.m. and from 1 p.m. to 2 p.m." Another rule says: "We appeal to our workmen's sense of justice and fair play (especially when work is urgent) not to stay out more than two hours per week, and we will not request them to work overtime unless it is positively necessary to oblige our customers." The list ends with a table of fines: "leaving off work before the horn is blown, 6d.; wasting oil or any other material, 1s.; loitering in the works, or being absent without sufficient reason, 1s.; smoking during working hours, swearing or using any bad language, throwing about, or otherwise causing any annoyance or disturbance, 1s." The last word, however, is: "N.B.—All fines will be devoted to the funds of the works' Sick Club."

Building Research, 1957

A MORE extensive study of the problems of management in the building industry was proposed by the Building Research Board in its programme for the next five-year period 1959–64. This is announced in the annual report, "Building Research, 1957" which has just been published by H.M. Stationery Office. The Building Research Station has already investigated some topics within this broad field, notably programming and site organisation. Yet much remains to be done, it is stated, especially in the building industry with its unusual structure, shifting labour force and out-of-doors operation. The Board also deals with the role of the Building Research Station, and emphasises that the station is the only organisation covering the problems of building as a whole, and is in a unique position to make an overall assessment of practical problems and to give comprehensive and independent advice. Research undertaken during 1957 is reviewed in the report of the director, Dr. F. M. Lea, and includes the following topics.

Partial Prefabrication.—A detailed study of methods of house-building using large factory-made components has been made. The Station considers that partial prefabrication of this sort is not necessarily economical. The odd jobs of filling in, covering joints and finishing, which still have to be done on the site, may offset any expected savings. To be successful, factory-made components should eliminate rather than reduce the need for traditional components and trade operations.

Programming Site Work.—An important preliminary to the actual construction of a building is the preparation of a detailed plan or programme of site work. In assisting the architects and the contractor for a secondary modern school in drawing up such a programme, the Station found that building time could be halved.

Construction with Bricks.—Under the stimulus of the Station's work on the packaging of bricks, the use of this method is now steadily increasing. Brickmakers are now delivering over 250,000 bricks in packs each week. All stages of handling are much improved—with increased speed, reduced labour costs and less damage.

In this country, the size and shape of the clay brick is generally taken for granted. It is clear, however, that larger perforated bricks could cost less to lay and give better heat insulation. The Station has developed such bricks and two brick-making firms have now made trial batches of a horizontally-perforated brick measuring 13in by 8⅛in by 2⅝in (about three times the volume of the usual brick). It has a central hand-hold and two grooves in the upper surface to interrupt the horizontal joint and so hinder rain penetration.

Roof Gutters.—Until now there has been no formula for calculating the size or other features of design of roof gutters. The Station studies show that rainfall characteristics, and patterns of flow off roof edges and in gutters are important matters and is about to publish detailed recommendations for designers.

Soil Mechanics and Structures.—A number of researches of special interest are described in those sections of the report concerned more directly with problems in civil engineering. Most of the work in this category is with soil mechanics or the design and performance of structures.

A research programme on shear in reinforced concrete has been started, with the object of developing a load-factor method of design for shear forces. Other structural investigations concern structural lightweight concrete, resistance to repeated and static loading of prestressed concrete, fire resistance tests on prestressed concrete, concrete for the shields of nuclear reactors, concrete-encased steel stanchions and the composite action of structures.

The Station was asked by the Ministry of Transport and Civil Aviation to help in formulating the design criteria for rooftop heliports. Such heliports must be capable of withstanding the maximum landing impulses that could be imposed upon them without collapse of the undercarriages by the largest helicopters likely to use them. In the foreseeable future these impulses might represent peak loads of up to 75,000 lb from each of two main wheels, attained in about 0·05 second after touch-down, maintained for about 0·1 second and falling to about the static load of 25,000 lb per wheel in a further 0·1 second.

In present structural design practice there is no adequate precedent for dealing with such loads, and in order to obtain direct information it is proposed to build a simple test structure with some of the characteristics of a rooftop heliport but consisting of little more than a large square slab of uniform section with various alternative supports, and so designed that heavy landings can safely be made on it by a suitably instrumented helicopter.

Report of Euratom Commission

THE total electrical capacity of the eight power reactors being planned or built for the members of Euratom, the European atomic energy community, is to be about 660MW, according to a report submitted to the European parliamentary assembly. Five of these reactors are to be in France, two in Italy, and one in Belgium (the remaining members of the community are Luxembourg, Holland and western Germany). Included among the plants listed is the "G1" reactor at Marcoule, France, which is now being run experimentally. The installed nuclear electrical capacity in the six countries is expected to reach in the region of 3500MW to 4000MW by 1965. The cost of nuclear power is stated already to be competitive with the cost of conventionally generated power in certain cases, and (according to a press release from the Euratom Commission), "it has been seen . . . that it will become more and more so." There are also to be nine research reactors in France, seven in western Germany, four in Italy, three in Holland, and two in Belgium. One German, one Belgian, and five French research reactors are already working.

An output of less than 700 tonnes of uranium is at present available annually to the Euratom countries, but this is to be greatly enlarged. The community has access to considerable reserves, and the need to import should progressively diminish. Most of the countries are still at the planning stage with regard to fuel processing and fuel-element manufacture.

The Commission's report states that, in line with the provisions of the Euratom Treaty (see THE ENGINEER, April 26, 1957, page 659), and with other current international agreements, "competition will not be limited to the industries of the six countries, but must be extended equally to the industries of other countries, in particular the United States and the United Kingdom." The expressed view is that "nuclear industry will have the best chance of development in a climate of collaboration and mutual contact leading to frank and healthy competition." It will be recalled that, only a few weeks ago, an agreement between Euratom and the U.S.A. was announced (see THE ENGINEER, June 27, 1958, page 982). We understand that negotiations are still in progress with the United Kingdom.

Motor-Cycle Innovation

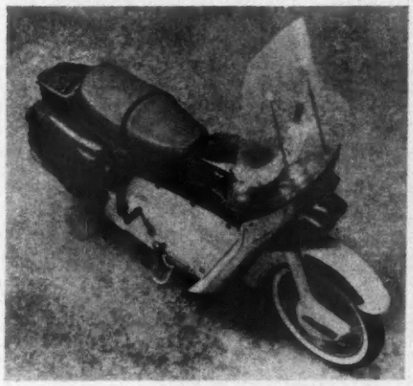
THERE has been introduced by Ariel Motors, Ltd., a new motor-cycle which, in some respects, departs radically from British practice; in particular, a windscreen is provided. As our illustrations show, a hollow box, fabricated from steel pressings, forms the main structure, the power unit being attached to three projections below it, the rearmost mounting bolt being also the pivot for the rubber-bushed rear fork.

The 54×54, 249 c.c. engine is a two-stroke parallel twin, a design which is now, after fifty years, regarded as orthodox. The engine is composed principally of aluminium alloy pressure die castings, the cooling pins on the cylinder heads being very thin and smooth to the verge of shining, while the primary chain case has cast-in the maintenance instructions relative to the chain tensioner. This tensioner, a steel strip faced with synthetic rubber, allows the gearbox to be accommodated in the same casting as the crankcases. The cylinders, which have staggered pins, are cast iron, the cost of chromed light alloy cylinders

being deemed excessive in regard to the weight saved, while the lesser distortion of the heavier metal is valuable, particularly because of the uneven heating of a ported air-cooled cylinder. The engine, with transfer ports each side of the exhaust port and inlet ports in the piston skirt, has an optimum ignition timing virtually invariant with speed, and the twin contact breakers thus have no advance-retard provision. The crankshaft runs on three ball bearings, the nearside two being merely a push fit on the shaft, to allow axial expansion, and has a keyed taper joint between left and right halves made and broken by a socket screw ; socket screws are also used to hold the heads. "Petroil" lubrication is used. The net ouput claimed is 16 h.p. at 6400 r.p.m.

The clutch runs in oil, and the plates, instead of being splined, have a cycloidal profile which engages with a correspondingly convoluted drum. The "Neolangite" friction elements are bonded to the plates and there is a rubber cush drive in the clutch centre. A cluster of Burman gear give downward changes 1·3, 1·4 and 1·75 wide. The final drive is by a chain enclosed as on previous models, in an unstressed dust cover, and lubricated from the primary chain case ; the gear ratio in direct drive is 5·9, and the maximum speed is about 70 m.p.h.

The front suspension employs a geometry unusual in this country, trailing links with a



The "Leader" in its fully equipped form ; the "tank" is a locker

brake reaction link in parallel. This system relies on the spindle to maintain the wheel attitude, but since the machine cannot be used with a sidecar this is considered acceptable. The geometry gives a constant wheelbase and, hence, a variable tail. To minimise angular movement of the telescopic suspension units, they extend to below the spindle, and, to reduce the reactions on the fixed pivot, are in line with the spindle, so that pierced stirrups are necessary to clear the spindle. These pivots all have lubrication points.

The machine is enclosed by steel panels, Bonderized and high-temperature stove enamelled ; those panels each side of the power unit are quickly detachable. The panelling is unstressed, and the passanger's footrests are attached to the swinging fork. Neither set of rests, nor the saddle or handlebars, are adjustable. The panelling includes a pair of narrow leg shields, a fairing for the fixed 5·75in Lucas headlamp (which can be adjusted in the pitch plane as the load on the machine varies by a control on the instrument board), and in the usual place for a fuel tank a lockable compartment within which are the steering head lock and the release for the saddle, below which are the petrol tank and filler cap. A braced "Perspex" windscreen is shaped to clear the short handlebars and is shallow enough for the rider to see over. Optional extras are panniers fitting on the sides and a carrier on top of the hinge-up rear mudguard. The standard machine weighs 300 lb.

We have experienced a short ride on the machine in a built-up area ; the suspension is good enough to allow heavy brake applications and passage over raised manhole covers on wet surfaces. The handling qualities at low speeds are remarkably docile ; the turning circle is

The hollow frame member of the "Leader" is open at the rear to admit the fuel tank. The rear engine mounting lug is part of the air intake system

smaller than even a narrow road, but there is a distinct tendency to straighten out as the engine comes on load. As would be expected, engine vibration is imperceptible, and the exhaust note is less voluminous than harsh. The minimum engine speed is kept somewhat high by a snatch attributable, perhaps, to the spring tensioner and cush hub in the primary drive. On a new machine the controls seemed heavy, except for the gear shift, which has a long travel and was quickly learnt.

This machine is not, of course, intended for applications demanding sustained high speeds, and the existing four-stroke range between 250 c.c. and 1000 c.c. will continue, unless limitations of manufacturing capacity dictate otherwise.

Mechanised Coal Depot

A STUDY of the economics of handling coal from mine to domestic consumer made by Charrington, Gardner, Locket and Co., Ltd., has resulted in the design and construction of a mechanised coal depot at Palace Gates, Wood Green. The scheme, which required the co-operation of the National Coal Board and British Railways, has been engineered by Charrold, Ltd., and handles coal at a uniform rate of flow with the minimum of degradation. As developed, the system means that a number of small depots can be closed and the work concentrated at Palace Gates. This is an aid to economy on the railway in the matter of the working of trains, while the solution of problems concerned with the friable nature of coal means a reduction in the quantity of slack produced during handling.

Briefly, the scheme consists of a siding, a conveyor delivering to another conveyor feeding bunkers from which the coal is bagged ready to be delivered by lorry. The annual throughput is about 55,000 tons and the plant can handle the coal at a rate of 120 tons per hour and load twelve lorries simultaneously. Three trains a week arrive at the depot and each consists of eighteen 21-ton hopper-bottomed wagons filled with graded coal and worked as a fast train of braked wagons, so as to achieve through routing. There are three sidings, two 600ft in length and a third 450ft long, and on arrival the trains are split into two sections and shunted on to the sidings and the engine collects the train of empty wagons for return to the coalfield. The arrangement provides for the minimum of shunting, allied with a minimum of degradation, and offers certain advantages to British Railways, including a high percentage of wagon utilisation. On the sidings, wagon movement is controlled by an electric winch which can position the wagons as required over the discharge hopper. The wagons are self-emptying and the receiver hopper is of minimum size so that a small initial fall of coal is sufficient to fill it and so form a column of coal between wagon and hopper, again helping to reduce damage to the coal. Our illustration shows wagons in the siding, the elevator delivering coal to the bunker building, and the Stelcon units forming the stock bays.

The under-rail hoppers, at each of which there

Mechanised coal depot at Wood Green

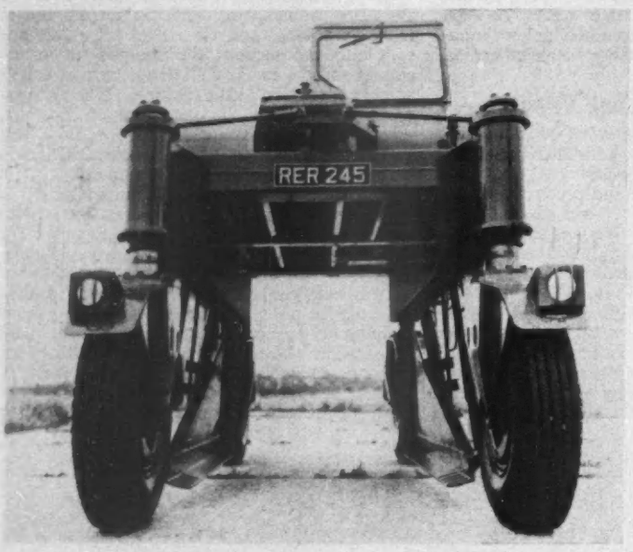
is a fine water spray to control dust, feed an elevating conveyor by means of reciprocating plate feeders, which are self-cleaning. The elevating conveyor, of articulated steel pan design, is 127ft long, has a capacity of 120 tons per hour and raises the coal 50ft above the delivery pit bottom at an angle of 30 deg. This equipment, by the cupping action of the pans, carries a higher volume of coal per foot run than a flat conveyor and by its steep operating angle reduces the ground space required. Furthermore, it changes direction of travel from the horizontal to inclined so that a second conveyor is not required and the drop between two conveyors eliminated. At the discharge end the coal passes either direct to a shuttle conveyor or via a double-decked, 60in by 160in vibratory screen, which has a top deck having 2in square apertures and a bottom deck having apertures $\frac{7}{16}$in wide, elongated on the discharge end to $\frac{1}{2}$in, so that any coal below $\frac{7}{16}$in is removed. Sizing can be adjusted as required.

There is a bank of twelve 20-ton hoppers to which the coal is delivered by a 36in wide, 120 tons per hour shuttle conveyor having head and tail drums at 70ft centres. The conveyor travels on rails and is controlled from a cab at one end. At the base of each hopper is a sack-filling feeder, and the discharge height is 11ft above ground level, while the bag scale platform is at 7ft and the platform at 3ft 6in. The overall length of the main hoppers is about 120ft and there are, in addition, two hoppers, placed behind the main bank, which take the slack from sizing screen and discharge direct into bulk lorries. The sack-filling equipment provides for a steady flow of coal of any size up to an 8in cube and the sack is filled at backing height and then carried direct on to the lorry platform. Each Charrold bagging unit has a capacity of 10 tons per hour and is powered by a $1\frac{1}{2}$ h.p. geared motor controlled by a foot switch.

On the site are storage bays, with an overall capacity of 6000 tons, and formed from Stelcon units, to hold stock against fluctuations in demand and supply. Coal for stock is delivered by the shuttle conveyor to end chutes, down which the coal reaches ground level. From this point it is conveyed by a Muir-Hill mobile shovel to the appropriate bay and stacked by a Fysons mobile conveyor. When required for delivery the stock is handled by the shovel and returned to the hopper circuit.

The ground area is laid with concrete and a mechanical sweeper keeps the depot tidy. Coke, anthracite and all grades of coal from 2in by 1in are handled by the depot, which has a weigh-bridge and an administrative block, including excellent facilities for those employed.

Suppliers: A.C.E. Machinery, Ltd., winch; Carlton Engineering Company, (Smithies), Ltd., unloading pit and feeders; Wharton Engineers (Elstree), Ltd., elevating conveyor; Niagara Screens (Great Britain), Ltd., screening unit and shuttle conveyor.



The hooks of the carrier are here fully open

Straddle Carrier Development

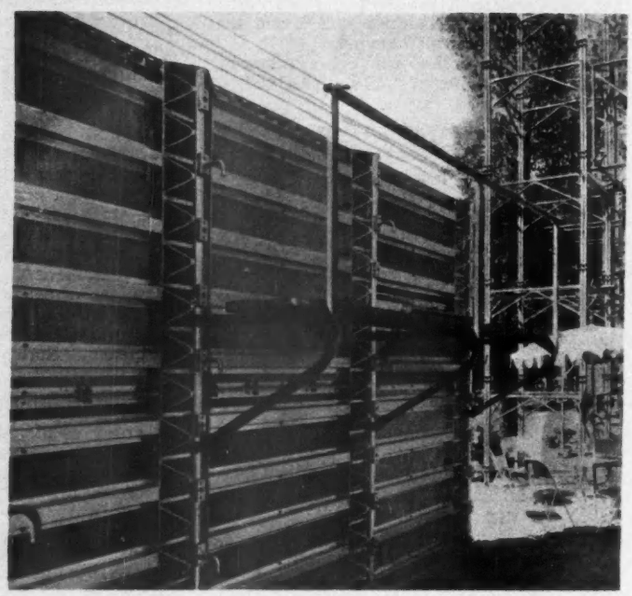
THERE was demonstrated recently at the Rochester aerodrome of Short Brothers and Harland, Ltd., the Mk. II product of the company's subsidiary, the British Straddle Carrier Company, Ltd. This differs from the British Straddle Carrier Mk. I (page 905, June 18, 1954) most conspicuously in having all four wheels the same size, whereas the early vehicle had the front wheels smaller than the rear, which were neither sprung nor steered. The new vehicle has a longer wheelbase, but the rear wheels may be steered in the opposite direction to the front to give a turning circle smaller than that of its predecessor. A more fundamental change is that the lifting hooks are no longer fixed laterally, requiring the vehicle to be driven accurately over loads of an exact width, but are swung about horizontal axes and may be forced together or apart by a hydraulic ram joining the upper ends of the guide tubes visible in our illustration; the lateral position of the pair of hooks is determined by the centre of gravity of the load. The hooks are lifted by bell cranks attached to two large torsion tubes running across the vehicle above the back and front of the hooks; the right-hand ends bear bell cranks joined by the hydraulic lift ram, and the left-hand ends further cranks joined by a connecting rod which keeps the two tubes moving in antiphase — thus no single failure, other than of the ram, can release more than one of the four lifting points. The ram has a check valve (requiring the load to be driven down) which, on production versions, will be between the ram and the flexible hoses.

The vehicle is driven by a Perkins L.4 engine giving 62 h.p., whereas the previous model took 65 h.p. from a P.6. A David Brown sliding-mesh gearbox gives three forward and three reverse ratios, the gear lever moving forward into forward gears and vice versa, and there is an Eaton two-speed reduction and differential. The drive passes by Hardy Spicer shafts to sprockets mounted on the top of the rear wheel carriers and thence by chain to sprockets outboard of the rear wheels; it is claimed that chain life is satisfactory without continuous lubrication, and an enclosed chain case is optional. A hand lever applies a disc brake which is on the input shaft to the Eaton change speed mechanism.

Each wheel is supported on a coil spring, no damper being employed. The steering gear is operated by a non-reactive Marles power unit; between the steering box and the front wheel drop arm there floats on the Pitman shaft the rear wheel drop arm, and a shear pin through the latter can be engaged either with the front wheel drop arm or to lock the rear wheels for road travel, a fixed location. The steering lock depends whether the load is or is not long enough to foul the wheels, but if not the inside radius of the turning circle is 10ft.

The small headlights are unsprung and turn with the front wheels; consequently they are mounted at 90 deg. to the normal attitude, giving a beam that is deep rather than broad. A third and similar lamp underneath the superstructure illuminates the load.

The auxiliary circuits, besides electric engine starting, comprise hydraulics for the load handling and the power steering, for which a separate constant-flow pump is fitted, and vacuum provided by an engine-driven exhauster to assist the driver's application of the hydraulic brakes and to drive the two-speed ratio change. The vehicle weighs 5 tons 15 cwt, lifts up to 9 tons, and can achieve 30 m.p.h.; the 54in carrier is 8ft wide.

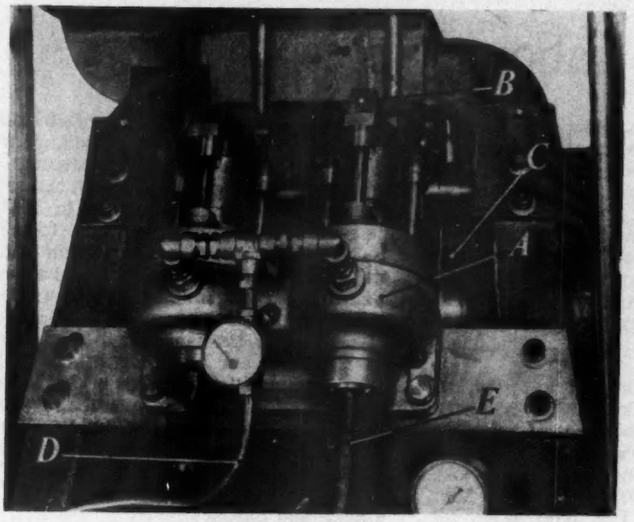


Shuttering assembly with steel-framed plywood-faced panels and soldiers

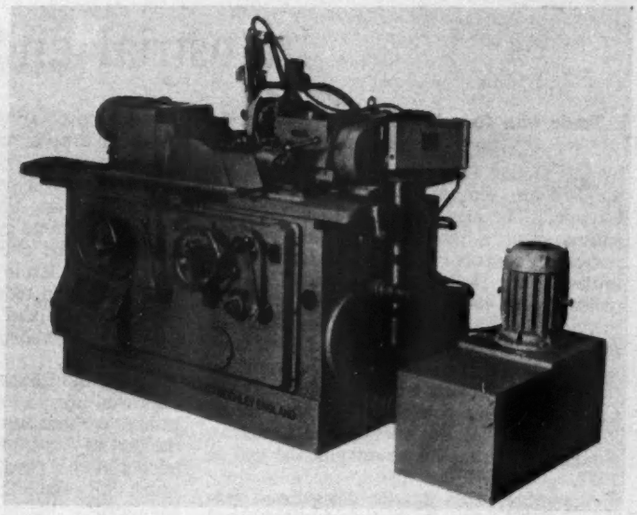
Plywood-Faced Shuttering Panels

THE accompanying illustration shows a shuttering assembly with plywood-faced panels, which has been developed by Kwikform, Ltd., Waterloo Road, Birmingham, 25. The panels consist of plywood stiffened by cold-formed "top hat" ribs of steel, the standard size of a panel being 4ft wide by 5ft high. The "soldiers" are also composite assemblies of steel and plywood, as the illustration clearly shows. The vertical tubular stiffener of each soldier is, in fact, a scaffolding tube, and scaffolding can be coupled directly to it, as, in fact, is shown by the scaffolding bracket.

The shuttering is intended for constructing lifts of 10ft in one pour. The assembly we illustrate is 10ft high, the panels being bolted to each other and to the soldiers by "tie-head couplers," which are tightened with a fixing tool. In the background is an access panel, 4ft wide by 1ft 8in high, which is shown open; concrete can be introduced at this level in the early stages of work, and later on the panel closed and bolted and the remaining concrete placed from the top. The ties and spacers used in this shuttering assembly are standard products of the company and have been described in these columns. The system also includes a "transfer aligner" for joining the shuttering against the company's steel shuttering, and "filler" panels which give any dimension within $\frac{1}{2}$in. The face of the soldier in contact with the concrete is 12in wide by 10ft high.



Pressure control equipment on a drawing press fitted with pneumatic cushion



High precision grinding machine with 3½in centre height

Press Cushion Pressure Control Attachment

A PRESSURE control valve equipment for use on metal drawing presses fitted with hydraulic or pneumatic cushions which is automatic in operation, has been developed by Tudor Development Engineers (Eton), Ltd., 29, Alma Road, Eton Wick, Windsor. It is designed to overcome the problem of progressively increasing blank holding pressures in the cushion due to area reduction during progress of draw. This control, by progressively reducing the pressure in a die cushion, enables a constant holding pressure to be maintained on the blank, according to the predetermined demands of a draw. It has a further advantage in that it can be arranged to impart an increased pressure in the cushion at the end of, or at any predetermined stage in, drawing.

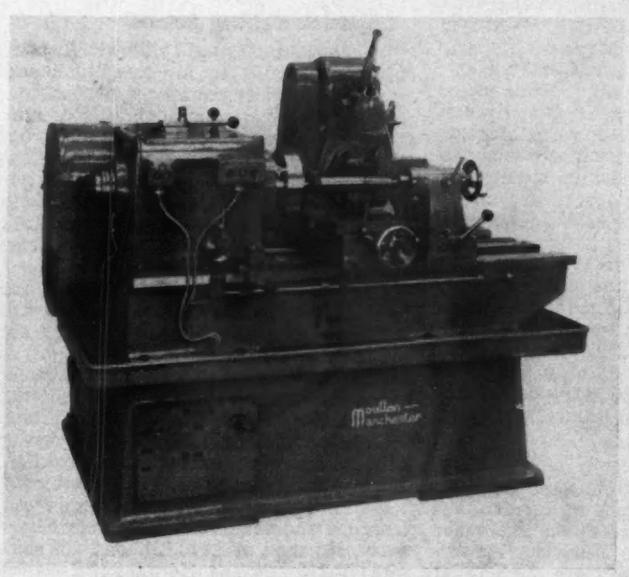
A press fitted with the control attachment is shown in the accompanying illustration. There are two interconnected valves, that on the right, *A* in the illustration, being what is termed the over-pressure valve, and that on the left the under-pressure valve. The over-pressure valve is connected through the pipe *E* in its base to the incoming compressed air main. The pipe connecting the two valves is coupled to the air line *D* to the press cushion. A spring controlled diaphragm in the over-pressure valve can be set to admit air at the required optimum pressure to the air cushion line, and this unit can therefore be regarded as a pressure regulating valve. The under-pressure valve has an adjustable needle release valve in its base through which air in the system can be released to atmosphere.

Spindles in these two valves are actuated through rocker arms *B* by an adjustable cam *C* on the press crankshaft, and this cam can be designed for the valves to be actuated together or individually to any required time sequence during the press stroke. Thus, for a drawing operation the over-pressure valve on the initial movement admits air to the system to give the maximum blank-holding pressure in the cushion. As the draw progresses, the over-pressure valve diaphragm seals off the incoming air supply and the under-pressure valve spindle opens the needle valve progressively with the cam profile rise to reduce the holding air pressure in the cushion line. If at any stage during drawing it is required to reintroduce full line pressure to the cushion, the cam can be designed to close the under-pressure needle valve and instantaneously or progressively open the over-pressure valve. By the use of a suitably profiled cam this procedure can be repeated if required at various stages of drawing. On the return stroke of the press the under-pressure valve is closed and full pressure admitted to the cushion line to eject the work-piece and raise the return pressure ring of the tool.

Thread Milling Machine

THE capacity range of the thread milling machines made by Geo. Moulton, Ltd., and marketed by Wickman, Ltd., Coventry, has been extended by the introduction of the new universal machine illustrated below. This machine is designed for cutting threads up to 5in diameter, either external or internal, on workpieces up to 20in between centres, and, if required, longer beds, lengthening by increments of 10in, can be supplied. The range of threads which can be cut on the machine extends from 32 t.p.i. up to 12in pitch by the use of the twenty-two standard change gears supplied, while gears are also available to cut metric threads. The design of the cutter head enables all normal helix angles to be cut, as well as straight splines to be milled singly.

Threads with multiple starts up to twenty-four in seven steps can be cut using the standard indexing plates, and plates for other numbers of starts can be supplied if required. For short thread milling, where the whole thread is cut in just over one revolution of the workpiece, the cutter spindle can be fitted with multiple cutters. The work spindle and the cutter spindle of the machine can be driven independently in either direction, and the standard pick-off gears give fifteen work spindle speeds from ¼ to 4 r.p.m. The cutter has five speeds from 212 to 850 r.p.m.



Universal thread milling machine for work up to 5in diameter

Grinding Machines

UNDER a revised manufacturing programme, Keighley Grinders (Machine Tools), Ltd., Keighley, has introduced some new machines, and rationalised the basic hydraulic control systems of all the grinding machines it makes so that component parts and sub-assemblies are interchangeable between machines. A new angle head machine for heavy duty plunge cut grinding has a 12in swing and is available with beds giving from 24in to 72in capacity between centres. This machine can be equipped for either an intermittent pick feed from 0·0002in to 0·001in, or intermittent plunge feed from 0·0001in to 0·001in. The rate of hydraulic plunge feed is steplessly variable and a 2in rapid travel of the wheelhead provided. A special dressing feed which is applied by means of a hydraulic valve control is supplied as standard.

A high-precision grinder, known as the "K.L.G.G." model, is designed for use in gauge grinding, tool rooms or a high finish production machine. This machine, which is shown in the illustration above, has a specially designed rigid base casting supporting the vee and flat ways of the table. It has a 3½in centre height and is made in two models with grinding lengths of 9in and 18in.

The dead centre workhead of the machine is stated to be four separate units connected by belts. The main workhead casting carries the dead centre spindle only, the layshaft and driving plate being mounted in separate castings and the motor placed behind these three units, all of which are mounted directly on to the table. Adequate provision for belt adjustment is provided without the use of any jockey pulleys, a vee rope being used for the primary drive and flat endless belts elsewhere. The drive is from a d.c. motor giving six speeds from 20 to 396 r.p.m.

The wheelhead is designed to ensure vibrationless operation and positive positioning. Its nitralloy spindle runs in self-adjusting bearings of thin white metal backed by cast iron bodies, controlled lubrication being provided by oil rings from the sump. The wheelhead drive is through a flat belt.

Industrial and Labour Notes

Trade with Canada

On April 24 a delegation, appointed by the Dollar Exports Council and led by Sir William Rootes, left this country for Canada. The eleven members of this delegation spent a month in Canada making personal contact with the regional committees of the Dollar Sterling Trade Council, collecting up-to-date information on commercial conditions for the guidance of British manufacturers and exporters and discussing with government and municipal authorities the subject of greater two-way trade between Canada and this country. The tour was a "follow up" of the visit of the Canadian Trade Mission to this country at the end of 1957.

Yesterday, the British delegation published its report. It includes some useful observations on British exports to Canada, on British investment in Canada, and on the co-ordination of the British export campaign in Canada. The members of the delegation say that they were greatly encouraged by the positive response they received from all the Provincial Governments and Municipalities with which they spoke, and several of which have agreed to send their purchasing officers to this country for tours of inspection. As to general conditions in Canada, the delegation formed the view that, with a few exceptions, "economic activity had levelled off rather than receded." Despite the higher level of unemployment in Canada, the report says, there were more people at work in each month of 1957 than in the comparable month a year earlier. Nevertheless, it is added, "the unemployment problem is one which is still giving concern." However, the impression gained by the delegation was that Canadians seemed to be adopting a steady attitude towards the levelling off in activity and were not talking themselves into depression.

The report then goes on to record that a "recurring factor" in the discussions was the influence of existing conditions upon prices. The delegation heard of many cases where American tenderers had put in revised bids at prices with which British firms could not compete. While United States companies may be able to stand severe cuts to maintain a market, we cannot. These experiences apart, the report states, "there is evidence that our prices are now very near the border line between success and failure." The delegation emphasises that, at this stage, Britain dare not allow her costs and prices to increase. But one factor which arose to cloud the favourable atmosphere was the repeated reference to strikes in Britain, and specially unofficial stoppages at the docks. The delegation says it emphasised, of course, that days lost from strikes in Britain show a much better record than the U.S.A. or indeed Canada. Nevertheless, it is observed, Canadian importers have suffered before from lateness of delivery due to stoppages and "it was clear that this point alone, whether justifiable or not, is given as a reason for placing elsewhere a good many orders that would otherwise come to Britain."

Economic Prospects

The National Production Advisory Council on Industry met in London last Friday and was addressed by the Chancellor of the Exchequer, Mr. Heathcoat Amory. The Chancellor described the outlook at present as being more encouraging than in previous post-war years, mainly on account of the big drop in the prices of imported raw materials. In May, he said, prices of these materials were 11 per cent lower than a year earlier. So far, the Chancellor continued, there had been no general fall in retail prices, though, as the effect of the lower cost of materials was felt in the system of production and distribution, reductions might be expected. Already, there had been a slight decline in the average wholesale prices of manufactured goods.

So far, the Chancellor went on to say, the improved prospect for lower prices had been gained without severe unemployment. At the end of May, there were over 23,000,000 people in civil employment, and in only one year (1957) since the war had the total been significantly higher. The June figure for unemployment, 429,000, was only 2 per cent of the total labour force, and, the Chancellor added, many areas in the home counties had unemployment rates of about one-half of 1 per cent. An examination had been made of the areas recently identified as having a continuing unemployment problem; they accounted for nearly 21 per cent of the national total of wholly unemployed, although their insured employees were less than 8 per cent of the total in Great Britain. But, the Chancellor pointed out, many of these areas were deficient in the manufacturing industries which had been expanding naturally. Finally, the Chancellor said he believed that there was a better public understanding of the relationship between wages and prices. But, he went on, a general or widespread pattern of increases going beyond any prospective increase in national productivity would in itself be clearly inflationary.

The subject of wages and prices was referred to again by the Chancellor of the Exchequer in the House of Commons on Tuesday. He was then questioned about the Government's policy on wages. In his reply, the Chancellor said it would be a serious mistake to regard the recent credit relaxation as any justification for "an indulgent attitude towards costs and prices." The maintenance of the value of our money required continuing moderation in wages and salary settlements.

Lloyd's Shipbuilding Returns

The returns issued by Lloyd's Register of Shipping record that in Great Britain and Northern Ireland steamships and motorships under construction at the end of June amounted to 336 ships of 2,295,371 tons gross of which eighty-six ships of 547,668 tons are fitting out afloat. During the second quarter seventy-two ships of 386,913 tons were commenced, seventy-two ships of 344,512 tons were launched and seventy-seven ships of 362,471 tons were completed.

The tonnage of ships preparing, at 1,781,345 tons, is 622,709 tons or 26 per cent less than a year ago, while tonnage for registration abroad at fifty-three ships of 344,697 tons represents only 15 per cent of the total tonnage building and is the lowest figure since June, 1946. Oil tankers total seventy-four ships of 1,109,990 tons gross or 48·4 per cent of the total under construction. Work in hand abroad totalled 1315 ships of 7,838,126 tons gross while the commenced, launched and completed totals were respectively, 385 ships of 2,110,131 tons, 469 ships of 2,084,378 tons and 454 ships of 2,124,964 tons. For export the total was 3,727,899 tons or 47·6 per cent. A total of 285 oil tankers of 4,147,985 tons was building, or 52·9 per cent of the ships under construction. Work in hand throughout the world, excluding China and Russia, amounted to 1651 ships of 10,133,497 tons of which 22·65 per cent was the share of Great Britain and Northern Ireland. Of the grand total some 4,072,596 tons was building for export, of which 20·4 per cent was being built in Japan, 14·5 per cent in Germany and 8·5 per cent in Great Britain and Northern Ireland. Oil tankers accounted for 359 ships of 5,257,975 tons or 51·9 per cent of the total. Of the world total of steam and motor-ships 5,598,600 tons or 55·2 per cent were building under the inspection of Lloyd's Register.

Capital and Labour

At the annual meeting, last week, of The British and Commonwealth Shipping Company, Ltd., the chairman, Sir W. Nicholas Cayzer, Bt., put forward the opinion that we were now "in the midst of a recession." The course it would follow had to be assessed, he said, and the situation was such that if the nations of the free world failed at this time to grasp their opportunity they would deserve the fate which would befall them!

Sir Nicholas said there was no real conflict between capital and labour, for the one must be complementary to the other. Given the right climate of opinion and an enlightened approach to our problems, difficulties could be resolved. Money, he added, was like any other tool of a trade; it was made to be used and through its proper use business could be made to prosper. More and better jobs could be created and more opportunity could be given to those who had the will and the ability to assume responsibility. Sir Nicholas said that he subscribed wholeheartedly to the concept of a property-owning democracy, for he thought that to look after one's own possessions, whether those possessions were skill, money or the simple things of one's own home, was a great creator of happiness and an incentive to further effort.

In this fast moving age, Sir Nicholas remarked, there was great need for enlightened leaders, but true leadership could not prevail if all the time it was necessary to pander to popularity. Discipline and self-restraint were important factors for irresponsible strikes simply could not be afforded. In a democracy it was fundamental that a man should be allowed to withdraw his labour, but this right, Sir Nicholas emphasised, brought its own responsibilities which should not be disregarded lightly.

Railway Shopmen's Wages

At the beginning of the week, it was announced that the unions representing the engineering workers employed in British Railways' shops had accepted the offer of a 3 per cent wage increase made recently by the British Transport Commission. When the offer was made, the British Transport Commission called for full co-operation from the unions in measures necessary to secure the maximum productivity and economic working of the railway industry. The increase is retrospective to June 30, and it is understood that the shopmen's pay will be included in the review of wage levels of other railway workers which is expected to begin next month.

Swiss Transformer Factory

A new works for the manufacture of power transformers was the focus of attention during a series of open days held recently by the Oerlikon Engineering Company, Zurich. The first stage of this development is now complete ; it includes a new test department, part of which is equipped as a high-voltage laboratory, with a 3·2MV impulse generator and a 1000kV cascade transformer as described below.

UNTIL recently the manufacture of transformers by the Oerlikon Engineering Company, Zurich-Oerlikon, was carried out in a group of buildings which also contained a number of machine tools as well as erection bays for large rotating machines. To meet the growing demand for manufacturing space it was decided to build a new transformer works to the north-east of the existing built-up area. This decision, which is being implemented in stages, provides greatly improved conditions for transformer manufacture and leaves additional space in the older buildings for expansion of other manufacturing interests, such as large machines.

It is planned to build five halls, running roughly east-to-west, adjoined on the east by a building at right angles to the others. The first stage of this development has now been completed. It consists of an L-shaped block, in which the long limb, 72m long by 24m wide by 20m high, houses the main erection bay at one end and test bays at the other. The shorter limb, at right angles to the main bay, houses the high-voltage laboratory and a machine room (which can be extended when required) to supply power to the test bays.

In the interests of economy, manufacturing cleanliness and safety the workshop layout is sequential (from erection to test bay to high-voltage laboratory) with segregation of the working areas. A central passage way down the main shop separates the drying-out and impregnation areas on one side of the passage from the assembly and despatch area on the other and both these areas are separated by a transverse gangway from the test area and the high-voltage laboratory beyond it. This arrangement minimises the transport of work during manufacture and avoids the need for unnecessary transit through the test area.

The erection bay is at present served by one 120-ton crane and two 2-ton swivelling gantries. To provide safe and ready access, without ladders, to transformers during assembly the erection area is equipped with multi-level platforms on adjustable steel scaffolding. The installation is designed for the manufacture of three-phase transformers up to 250MVA and single-phase units up to 200MVA.

In the impregnation area on the other side of the central gangway there is a vertical vacuum tank, 5m in diameter for drying out transformers. There are also a number of drying ovens which are due to be replaced soon by a vertical vacuum tank measuring 11m by 4·1m by 5·2m, equipped with pumping equipment designed to exhaust 7000 cubic metres per hour. The adjoining oil impregnation plant contains oil storage tanks of 10 to 40 tons capacity, high-vacuum-tight filters, and two-stage vacuum-pump equipment of 600 to 1500 litres per hour.

The main bays are steel framed with brick walls and glazing carried out mainly in "Thermolux" glass. Extensive use was made of Franki piles to provide foundations in the subsoil consisting of fine river sands. The top soil was heavily compacted and ample concrete fillets were provided around the foundations to allow for a level floor with a loading of 10 tons per cubic metre without the need for having separate erection bedplates. Draught-free heating is provided by the Sulzer system with water at 180 deg. Cent., the radiators being installed at two levels—along the crane runways and below the ceiling as can be seen in Fig. 1. Artificial lighting is derived from a combination of mercury-vapour lamps suspended from the ceiling and fluorescent tubes fitted along the walls.

The planning of the test area and of the required test plant capacity was based on a statistical study of the future manufacturing programme, taking account of the sizes of the units and the time required for tests both before and after tanking. On this basis it was calculated that a floor area of at least 450 square metres would be required.

Similarly, bearing in mind that direct supplies of electricity for transformer testing were impracticable because of the poor power factor, the design study showed that the transformers would fall into three classes according to their power requirements for no-load and short circuit tests and heat runs. The reactive power requirements for these three classes were found to be : (i) <1MVA, (ii) >1< 3·4MVA and (iii) >3·4MVA, and it was calculated that a separate generator should be installed for each of these three power categories, to provide optimum usage of the test area.

To produce the three classes of power supply there are three motor-generator sets (as described more fully below) with two auxiliary sets

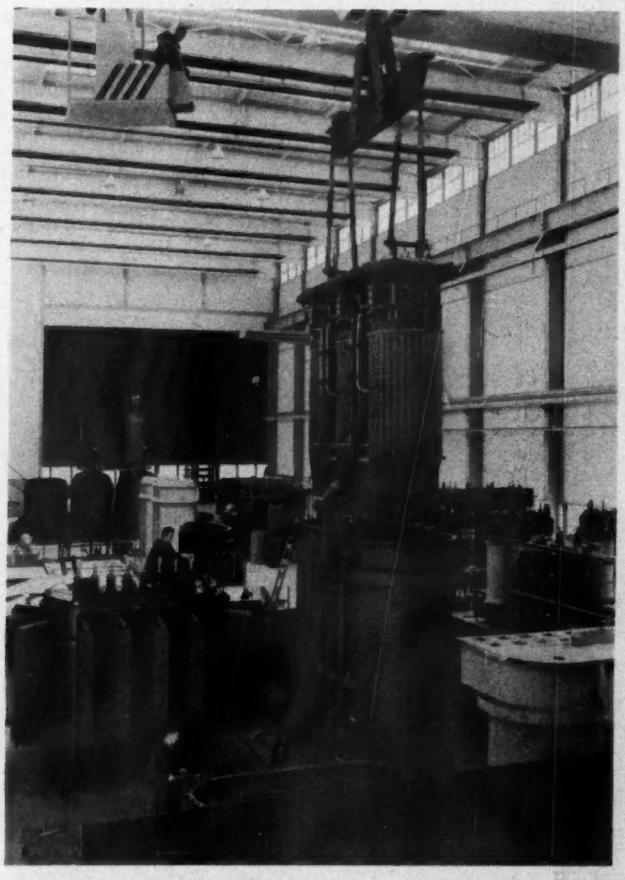


Fig. 1—Transformer works, assembly and despatch area. In the high-voltage test laboratory beyond, are the cascade test transformer and the impulse generator

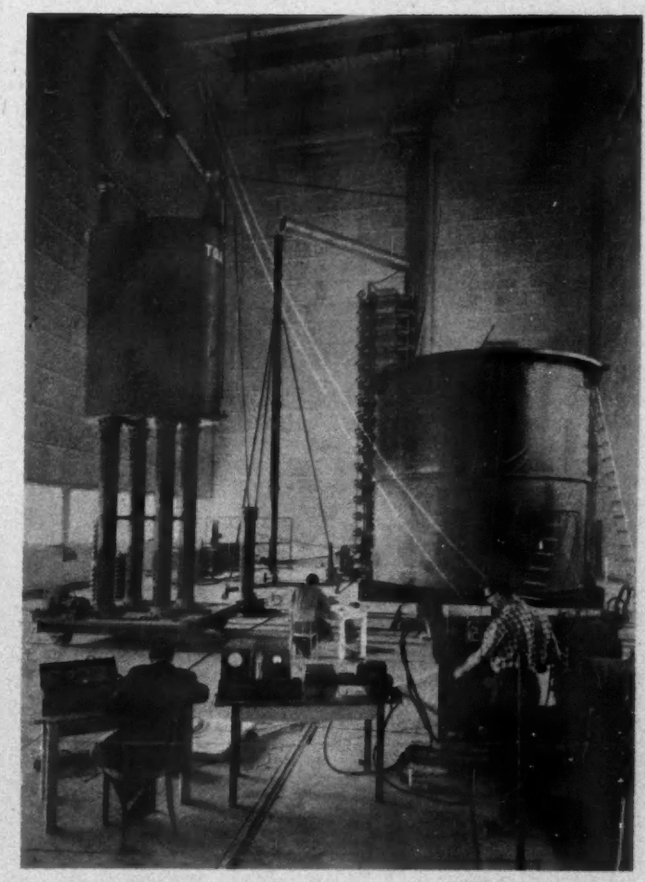


Fig. 2—High-voltage laboratory with (left) final stage of 50 c/s cascade transformer of 1000kV; (centre) 3·2MV impulse generator ; (right) transportable test tank

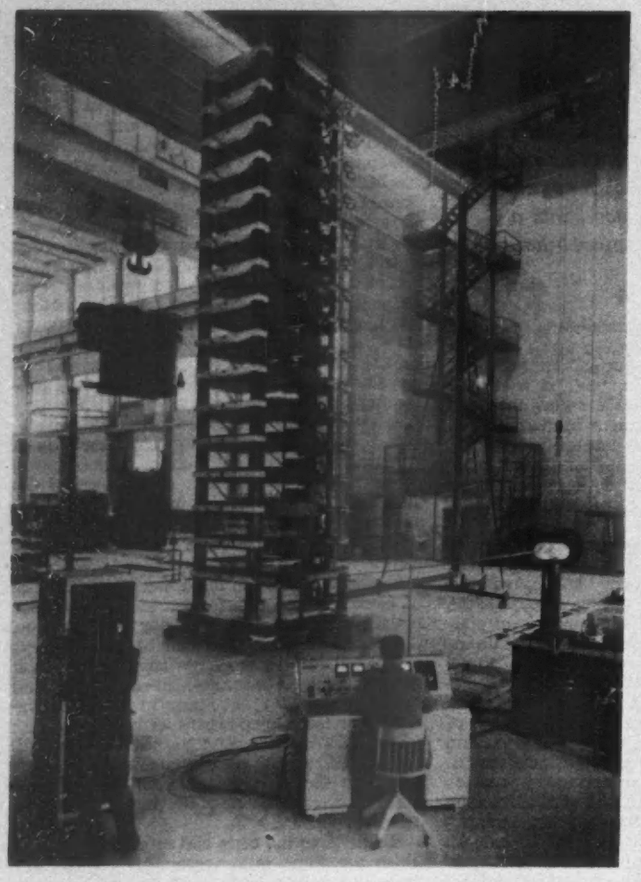


Fig. 3—High-voltage laboratory, with 3·2MV impulse generator. Beyond the laboratory is part of the transformer works

and exciter sets. From these sets a number of testing stations can be supplied simultaneously with three-phase and single-phase power, of adjustable voltage and frequency, and with direct current. On each three-phase alternator the windings are brought out to terminals to allow for series-parallel and star-delta connection. The maximum three-phase voltages on the three sets are 16kV, 6kV, 3kV and 1kV. The fields of the main exciters are supplied by remote control from a stabilised d.c. source.

For class I testing, as defined above, there is a turbo-generator designed for a continuous three-phase output of 42·5MVA and 16kV maximum at 50 c/s, 3000 r.p.m. A coupling which can be disengaged connects this generator to a machine rated at 3·6MVA, 50 c/s, 6kV maximum, which can operate either as a driving motor from the factory mains or as a variable-frequency alternator for test supplies. Solidly coupled to the 3·6MVA alternator is a 600kW d.c. machine which can run as a starting motor or as main exciter for the main alternator or as a d.c. generator for providing test supplies. Both alternators are cooled by an air-water heat exchanger which is part of the cooling system of the whole test plant.

When the 42·5MVA alternator is not required for service the 3·6MVA machine can be uncoupled and used to supply power for the class II tests.

Test supplies for class II can also be taken from a slow-speed set (375 r.p.m.) consisting of a 2·8MVA, 50 c/s alternator, a 2·7MVA synchronous motor and a 2·6MW d.c. machine. This set can be synchronously run from the factory mains or it can be driven by the d.c. machine, giving an output frequency of 16⅔ to 60 c/s. Cooling air for the two a.c. machines is drawn from the basement machine room and discharged to atmosphere or used to heat the building as required.

A third set is installed for the test supplies designated above as class III. It consists of two 1000kVA machines and two 600kW d.c. machines, which can be coupled to run either as one set or as two separate a.c./d.c. sets. When uncoupled the machines can be run as a Ward-Leonard set, generating at frequencies up to 60 c/s. One of the three-phase machines can be connected to the factory network and be synchronised through a starting reactor. Both a.c. machines are identical and can be run in parallel as motors or generators.

For providing test supplies at frequencies up to 400 c/s there is a fourth set which consists of two three-phase alternators, each rated at 1000kVA, 3kV, at 3000 r.p.m., and driven by a 600kW d.c. machine, which is identical in design with the machine in the third test set.

There is a fifth set which is used for starting up and for supplying small requirements up to 400kVA a.c. from two identical three-phase alternators or 500kW from a d.c. generator. To obtain this d.c. output one of the 200kVA alternators is used to assist the 480 h.p. synchronous induction motor, which drives the set.

Although there is an exciter allocated to each alternator, additional flexibility of operation is obtained by arranging that any exciter and any rotor can be connected together through two excitation busbars. Remote control is exercised over all the exciters and over the speed of the machine sets when they are Ward-Leonard connected.

A separate distribution system is provided for the high-power generator (42·5MVA); it is designed for 16kV with a continuous current of 5300A and a transient short circuit of 120,000A. The main distribution system is insulated for 10kV and caters for all the other test supplies. Any of these supplies can be connected through circuit selectors to copper busbars. From these bars the main distribution to the test area is by ten aluminium busbars each of 100 square millimetre section. The latter system is also used for transmitting d.c. supplies to the test area; two conductor bars can carry 2500kW at 600V.

To minimise the lengths of improvised conductors between the busbars and plant under test the test area is provided with a number of connection stands. Five of these stands in the transformer erection area consist each of four cubicles in each of which are the terminals of the three-conductor system. There is a sixth connection stand, which is equipped with two terminal cubicles, on the wall between the test bay and the high-tension test room.

The earthing of the test installation was designed with particular regard to high-frequency impulse voltages. All the concrete floor reinforcement was in two layers, all cross-over points being carefully welded together, to ensure good capacitive coupling between parts of the earthing system and between it and the surrounding soil. Electromagnetic shielding of the busbar ducts was provided by wire netting of 5cm mesh. Low-frequency earthing for the transformer works as a whole was provided by nine tubes with a resistance of less than 0·3 ohm.

Since transient short circuits up to 120,000A and continuous faults up to 11,000A can arise in the test installation all machines and connection stands are connected to the earthing screen by copper conductors of 480 square millimetre cross section. Equipment under test can be connected to this earthing conductor at different places in the test area.

Water cooling is provided for dissipation of the power losses in the machine bay and the test transformers. It consists of a ring main, water/air heat exchangers, and pumping set designed for a flow of 2000 litres per minute.

High Voltage Laboratory

Two principal test supplies are available in the high-voltage laboratory: they provide, respectively, test voltage of 1000kV at frequencies between 16⅔ c/s and 400 c/s, and impulse voltages of 4MV. Since both these test facilities are not required simultaneously it has been possible to make parts of the test plant mobile and thus to reduce the dimensions of the h.v. laboratory building, as determined by the minimum safety clearances. Indeed, the floor area of 18m by 30m is a good deal less than it would have been

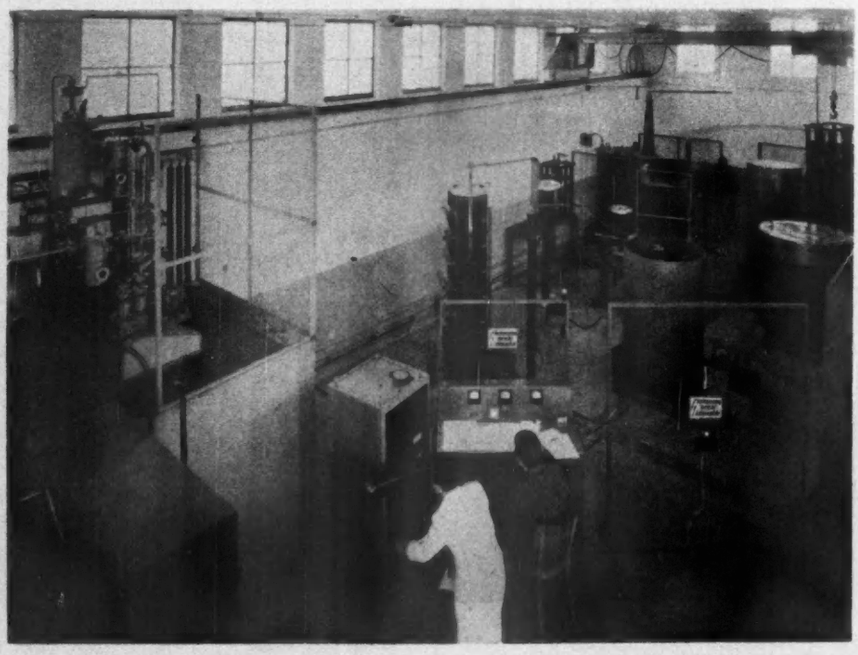


Fig. 4—Insulation testing laboratory. The equipment includes a 600kV, 1·6kW-second impulse generator

if the impulse generator and the high-voltage a.c. test plant had had to be fixed in their working positions. The free height of the laboratory building is 20m.

A three-stage cascade transformer (Fig. 2) constitutes the 1000kV a.c. test voltage source and can give an output of 1200kVA. The lower voltage supply for this cascade transformer is taken from one of the converter sets described above.

Impulse voltages are derived from a Haefely sixteen-stage impulse generator which is designed to operate at 3·2MV, with a stored energy of 160kW-second but can be modified by adding further stages to operate at 4MV with stored energy of 400kW-second. The generator is based on the Marx principle and the complete sixteen-stage assembly is mounted on a wheeled trolley running on rails (Fig. 3), whereby the complete equipment can be moved to different positions inside the high-voltage laboratory.

Each of the sixteen stages has a capacitance of 0·5μF which is charged to the stage energy of 10kW-second at 200kV by an oil-immersed selenium rectifier. These stage capacitors are enclosed in oil-filled metal casings which are insulated one from another by insulating rods. Any required series-parallel combination for discharge can be achieved with the help of the connecting clips. By making use of condensers and resistors of low inductance and of a non-inductive current path for the discharge it has been possible to keep the damping resistors small. Accordingly when transformers of large capacity are being tested the steepness of wave front can be made to approximate closely to the conditions specified.

It is stated that because of the low inductance and low weight of metal in the resistors the generator can produce in sequence two impulses per minute at full voltage. Discharge of the generator can be initiated manually or automatically, either synchronously or after any desired time interval, by using "Trigatron" triggering.

Voltage measurement with the cascade transformer is done through a capacitance divider; with the impulse generator use is made of a Haefely-Berger voltage divider surrounded by ring condensers with a series capacitance of 400 pF. The impulse voltage divider has a low inductance and a resistance of 15,000 ohms makes it possible to use voltage division which is either purely capacitive, or capacitance-screened ohmic or mixed. There is also a purely ohmic divider of 1·6MV. Observation of surge characteristics can be made on a double-beam hot-cathode-ray oscillograph. The equipment also includes an arc gap between two 1m diameter spheres with provision for 2m diameter spheres, if required. Among the useful pieces of ancillary equipment is a mobile tank (Fig. 2,) with a capacity of 50 cubic metres, which can be used for testing full scale models.

Control of both test voltage sources and of the sphere gap can be exercised from specific points in the high-voltage laboratory and from movable control desks in the test area (Fig. 2).

Tests on a smaller scale can be done in a separate insulation testing laboratory (Fig. 4). Here the test equipment includes a preparation plant, an impulse generator of 600kV and 1·6kW-second and a 50 c/s transformer of 180kV, 50kVA. In an adjoining room there is an electrolytic tank for plotting field distribution associated with experimental or projected schemes.

We understand that the high-voltage laboratory building is designed to be used, when required, for noise measurements on large transformers. Provision has been made for this sort of work by making the walls of very solid construction and by lining the walls with a layer of "Durisol," with an intervening air space. The walls are designed to limit the noise from the machine room and other external sources to 60 phons inside the laboratory itself. Acting in combination with the wall trusses, the wall linings act as a resonator and absorb acoustic vibrations of 50 c/s and higher frequencies. A heavy multiple partition will be used to close the opening to the erection bay (Fig. 1) which is 18m wide by 13m high.

Twelfth Achema Congress and Exhibition

No. III—(*Concluded from page* 111, *July* 18)

The twelfth Achema Congress and Exhibition of Chemical Apparatus was held in Frankfurt-on-Main from May 31 *until June* 8, *in conjunction with this year's Congress of the European Federation of Chemical Engineering, the Second Corrosion Congress, and other important meetings. The Achema (Ausstellungstagung für Chemisches Apparatewesen: "exhibition-congress for chemical apparatus") which is now held at three-yearly intervals has established itself as perhaps the most important event of its kind in the field of chemical technology. It seeks to bring into contact, on an international basis, the makers and users of chemical equipment, by means of lectures, discussions, demonstrations, and the exhibition itself.*

Edwards High Vacuum, Ltd.

A FULL range of vacuum plant and equipment was shown by Edwards High Vacuum, Ltd., Crawley. This included the model "GD1" high-sensitivity leak detector, which is applicable to outward leakage and vacuum apparatus. Samples of air from suspected areas are continuously induced over an electrically heated element, the temperature and, hence, resistance of which changes when leakage gas is induced. It is claimed that a leak as small as 1/50 oz of hydrogen per year can be readily located. The semi-automatic ampoule constricting machine (Fig. 2) can be operated with unskilled labour to

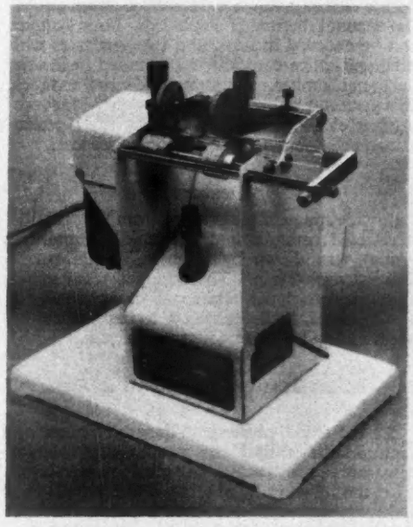


Fig. 2—Ampoule constrictor—Edwards

give reliably consistent results over a wide range of sizes. A small motor drives a system of rollers which rotate the ampoule stem above the flame of a blowpipe. The rollers grip the ampoule in such a way as to stretch the softened portion of the glass thus forming a perfect constriction.

M. K. Juchheim

Thermal and delayed and safety relays were among the products exhibited for the first time by M. K. Juchheim, Fulda. The safety relay incorporates two contact thermometers, one for the required temperature, the other, at a slightly higher temperature, for a built-in buzzer alarm.

Albert Balzer

Albert Balzer, Duchy of Liechtenstein, showed a "short path" vacuum distribution plant according to Utzinger, in corrosion-resisting all-metal form. Evaporation takes place from a film spread in an inclined channel over which a temperature gradient is being maintained A separation of the fractions in space as well as time is obtained.

Voigt and Haeffner A.G.

Voigt and Haeffner A.G., Frankfurt-on-Main, showed a high-duty, low-voltage switch for 120kA for short-circuiting one of a number of series-connected electrolytic baths while the remainder stay in operation. It can be operated by oil or compressed air, or by hand. Units up to 160kA have been produced.

Heraeus Quartzschmelze G.m.b.H.

An impressive selection of fused silica products and quartz glass was shown by Heraeus Quartzschmelze G.m.b.H., Hanau. Glasses are produced giving ultra-violet transmission down to 1650Å, and without the absorption band at 2400Å. "Rotosil" opaque fused silica is made in the form of vessels up to 200 litres and tubes up to 450mm internal diameter. Among the exhibits was a new double-distillation apparatus for producing up to 1·5 litres per hour of water of 1·1–1·8 × 10^6 ohm cm^3. Remarkable for its size was a fused silica dish of 2000 litres capacity.

Goetzewerke A.G.

A number of rotating shaft seals were exhibited by Goetzewerke Friedrich Goetze A.G., Burscheid, near Cologne, of which we illustrate, as the latest development, the design in Fig. 3.

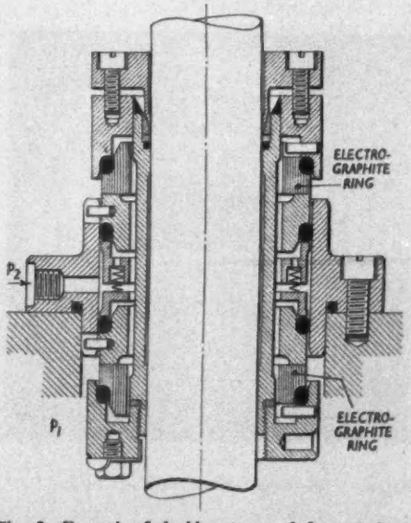


Fig. 3—Example of double rotary seal for a shaft of 125mm diameter at 88 r.p.m. Pressure of nitrogen is 12 atmospheres gauge, the pressure of the sealing emulsion is 15 atmospheres gauge—Goetzewerke A.G.

This double-acting pattern operates with a sealing fluid under pressure, which, at the same time, acts as lubricant. Pressure differentials, it is stated, can reach 40 atmospheres, and working temperatures 200 deg. Cent., or over, while maximum sliding speeds can be up to 20m per second.

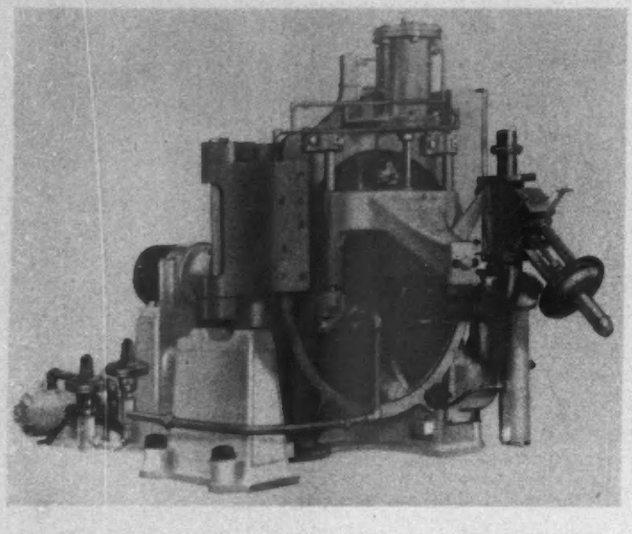


Fig. 4—C-41 " Super-D-Hydrator " with hinged cover—Sharples Centrifuges

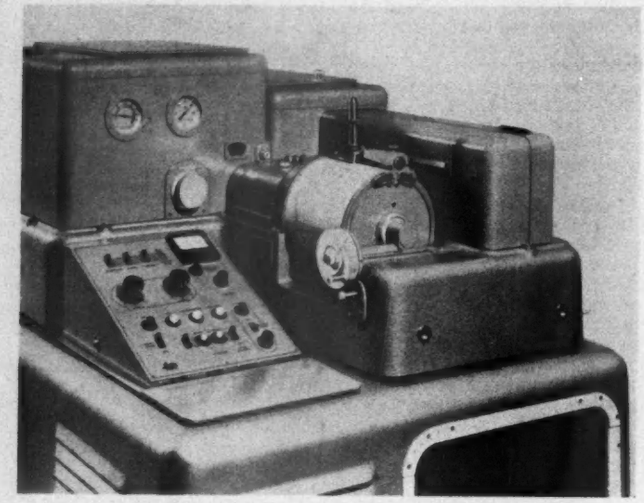


Fig. 5—Infra-red spectrograph—Ernst Leitz G.m.b.H.

Sharples Centrifuges, Ltd.

Sharples Centrifuges, Ltd., Camberley, Surrey, showed examples from the increased range of " Super-D-Hydrator " automatic continuous centrifuges of the perforated basket type for separating, washing and dehydrating slurries of all forms of crystals from the coarsest to the finest. The C41 " Super-D-Hydrator " is illustrated in Fig. 4.

H. Maihak A.G.

After one year's field tests in German oilfields, H. Maihak A.G., of Hamburg, 39, Germany, have now put into production the " Model SR-1 " alarm-regulating and control device, which automatically controls oil production not relative to time, but relative to borehole pressure. This, it is stated, permits maximum economic output and optimum preservation of the natural oil reserve, by guaranteeing that delivery from the oil well does not take place within the gas-releasing pressure zone. The " SR-1 " shown in Fig. 6, is a two-point

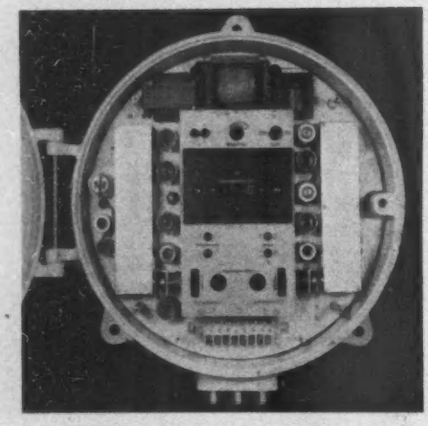


Fig. 6—" SR-1 " oil well controller—H. Maihak A.G.

control instrument, which, on intermittent production, switches the pumping equipment on and off relative to the flow pressure, and on continuous production switches on either a high or a low rate of production.

The borehole pressure is continuously transmitted from the bottom of the borehole by means of sound frequency oscillations, to the " SR-1 " Control Device located at the surface. The " SR-1 " comprises two frequency selectors which are released at the selected pressures.

C. H. F. Müller, A.G.

C. H. F. Müller A.G., Hamburg, showed a vacuum spectrograph for X-ray analysis. "White" X-rays are made to impinge on the sample which sends out X-rays of definite wavelength corresponding to the elements which are present. These secondary X-rays are analysed by means of a single crystal analyser. Reproducibility is ensured by using a magnetically and electronically stabilised d.c. mains unit. For tests on lighter elements down to atomic number eleven, the vacuum method is employed. Four samples can be exposed in turn, and two analysers with different lattice constant are mounted inside the vacuum chamber. For automatic series analyses, the concentrations of up to twenty-four preselected elements can be found by the Norelco-Autrometer, built under American licence.

Degussa

A wide range of parts made from " Degussit, " a sintered ceramic material (chiefly aluminium oxide), was shown by Degussa, Abt. Degussit, Frankfurt-on-Main. These ranged from miniature insulators for electronic tubes measuring 0·47mm o.d. by 0·20mm i.d. to ceramic cutting tools for speeds up to 450m per minute.

Jenaer Glaswerk Schott and Gen., Mainz

At the stand of Jenaer Glaswerk Schott and Gen., Mainz, several large assemblies of chemical apparatus constructed in glass were shown. For the chemical, pharmaceutical, and food industry, an all-glass propeller pump has been developed which at 930 r.p.m. delivers 180 litres per minute against a head of 3m. The glass-glass bearing is lubricated by the working liquid, leakage, which amounts to only a few cubic centimetres per hour, being returned to the vessel.

Deutsch and Neumann

Deutsch and Neumann, Berlin-Charlottenburg, 1, exhibited its high-pressure autoclaves, including one equipped with a glandless magnetic mixer. The absence of a gland and gland lubrication makes for easier servicing and enables oxygen to be used. The magnetic stirrer is actuated by two coils so as to give positive action both on the up as well as on the down stroke.

Julius Peters

The firm Julius Peters, Berlin NW 21, Stromstrasse 39, showed a photo-chronograph (Fig. 8) for analysing high-speed phenomena such as detonations of liquid or gaseous fuels. The chronograph makes use of a revolving drum carrying a film moving at speeds of up to 100m per second.

Ernst Leitz G.m.b.H.

An improved version of its infra-red spectrograph was shown by Ernst Leitz G.m.b.H., Wetzlar (Fig. 5). The instrument can be operated by hand or automatically. By means of a multiplier behind the monochromator slit, and the use of a hydrogen discharge lamp, or other light sources, measurements can be taken in the visible and ultra-violet range, without removal of the aligned thermocouple being necessary. The prism can be replaced by a grating, and measurements can be taken with polarised infra-red.

Mention may also be made of the " Dialux-Pol " and other polarisation microscopes and the ultramicrotome after Fernandez-Moran (Fig. 7) in which the specimen is rotated through 360 deg., in sapphire vee-bearings, past a dia-

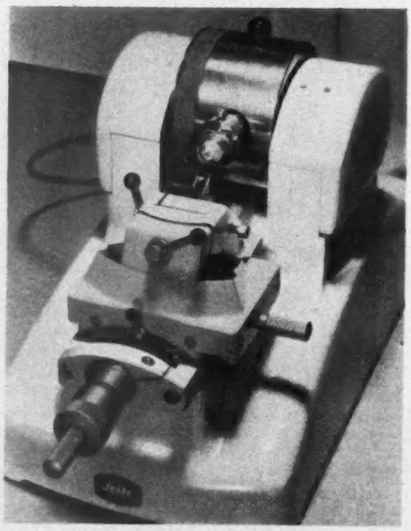


Fig. 7—Ultramicrotome, showing belt-driven specimen carrier. In front is the support for the knife edge, with a water trough behind the latter, which receives the sliced specimens—Ernest Leitz G.m.b.H.

mond or glass cutting edge. Thicknesses of 100 to 200Å are stated to be possible, the feed being obtained by heating and thereby expanding the specimen holder.

Colora

On the stand of Colora G.m.b.H., Lorch (Württ.), were shown a number of modern laboratory equipments among which we mention the automatic apparatus for redox titrations, which is stated to be universally applicable both to slow and to fast titrations.

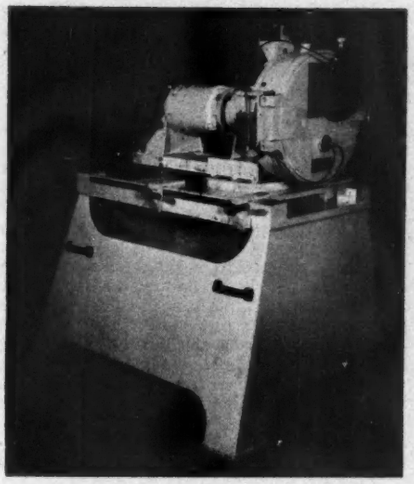


Fig. 8—Photo-chromograph for investigating luminous high-speed phenomena such as combustion processes—Julius Peters

SARTORIUS-WERKE A.G.

An automatic analytical laboratory was demonstrated by Sartorius-Werke A.G., Göttingen, comprising analytical balance, liquid level indicator (with silicon photo cell) for reading burettes, titration machines, automatic burettes, and automatic weighing machine for preparing weighed samples. Readings of the balance are taken digitally. An electric programming computer, and an electric typewriter, make it possible to select a programme (by means of a telephone dial) and to obtain the typed result of an analysis.

GUTEHOFFNUNGSHUTTE STERKRADE A.G.

A melting pot for sodium hydroxide, stated to be of unusually large size, was exhibited by Gutehoffnungshütte Sterkrade A.G. For withstanding the high thermal stresses (up to 450 deg. Cent. inside, 700 deg. Cent. outside), spheroidal graphite castings have been found particularly suitable. The present vessel, which has an internal diameter of 2·95m, an internal depth of 2·17m, and a finished weight of 12 tonnes, required for the casting 18 tonnes of magnesium treated spheroidal graphite iron.

BOPP UND REUTHER G.M.B.H.

High-pressure shut-off valves, initially for up to 320 atmospheres, have been introduced by Bopp und Reuther G.m.b.H., Mannheim-Waldhof. Forged from "C-22" or chromium-molybdenum alloy steels, the compact valve body for weld-connection has welded into it a piece carrying the hard-metal valve seat (Fig. 11). A membrane-operated, balanced reduction valve for steam operates without external energy and closes perfectly under zero demand. Other items include a pneumatic transducer for differential pressure measurements equipped with membrane connections and equalising valve, for highly corrosive liquids, and a pneumatic transducer for liquid level or density measurements. Similar to the A.P.I. design, but novel on account of the high working temperature of 648 deg. Cent., was a 36in gas valve, used in butadene manufacture by the Houdry dehydrogenation process. The valve has been designed to operate horizontally. Parts exposed to high temperatures are nickel-molybdenum steel castings, and the valve seatings are weld-faced "Stellite."

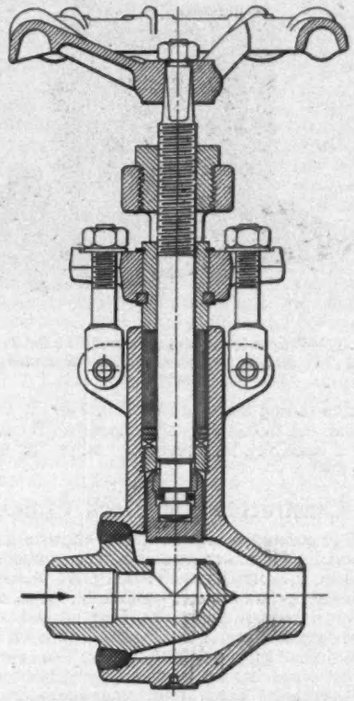


Fig. 11—Section through high-pressure shut-off valve—Bopp und Reuther G.m.b.H.

CARL ZEISS

The "Model B" Abbé refractometer, by Carl Zeiss, Oberkochen/Württemberg, has been designed to be absolutely liquid- and gas-tight and insensitive to corrosive substances, and to be used up to about 200 deg. Cent. In another instrument, this principle of the Abbé refractometer was shown combined with photoelectric measuring and control equipment, enabling continuous automatic measurements to be made for telemetering and process control. This instrument uses reflected light—which is important in the case of strongly opaque liquids—and works from $n_D = 1 \cdot 3$ to $1 \cdot 7$ with an accuracy stated to be 1 to 2×10^{-4}. An automatic sugar refractometer employs the Faraday effect, using the green 546·1mμ Hg-line. The polarisation angle of the sample is compensated by the polariser being turned back by a phase-sensitive motor. Readings covering ±100 deg. S. to the nearest 0·05 deg. S. appear in projection on a matt glass screen. Photo-electric indication and compensation to zero by counter-rotating the polariser is the principle of a precision polarimeter with a stated accuracy of ±0·0025 deg. The readings of the circular glass scale are projected.

In order to simplify electrophoretic routines in clinical medicine, the "Model II" extinction recorder has been supplemented by an electric integrator (Fig. 9) which enables the extinction and integral curves to be simultaneously recorded.

The "Model RPQ20A" is a spectrum photometer based on the optics of the "Model PMQII" but equipped for automatic recording in the range of wavelengths 200mμ to 2500mμ. This firm also showed a microscope fitted with Siemens and Halske industrial television.

DAWE INSTRUMENTS, LTD.

A very compact instrument for comparing the intensity of similar sounds was shown by Dawe Instruments, Ltd., Ealing. Measuring only 8¼in by 3¼in by 2¾in, and weighing 2½ lb the miniature battery-operated instrument was designed particularly for the use of architects, builders and engineers.

AGFA-PHYSIK

For many years, Farbenfabriken Bayer A.G., Leverkusen, has been developing testing equipment and measuring instruments for its own use as well as for other firms in the chemical and plastics field. In order to step up the output of such equipment, the company concluded an agreement with AGFA Camera-Werk, Munich, for a special department, AGFA-Physik, to be set up to handle production and sales. Among the exhibits at the Achema were an electronic rotation viscometer for rheological examinations of substances such as high-polymer solutions, ground pigment and surface coating formulations and fats. An automatic turbidity titration photometer is stated to supply information within a few hours on the molecular weight distribution of high polymer substances, data which can otherwise only be obtained by very time-consuming methods.

This firm has also introduced a thread tester which measures the strength and deformation, under static and dynamic loads. A solidification chronometer registers the viscosity of casting resins during setting. Our illustration, Fig. 10,

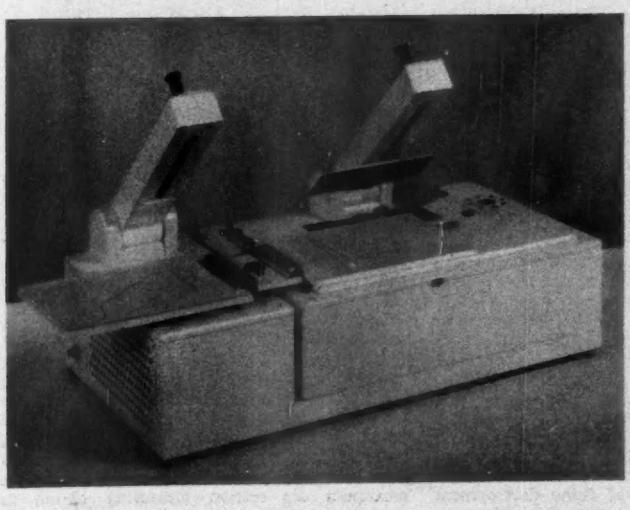


Fig. 9—Extinction recorder with integrator; heads in raised position—C. Zeiss

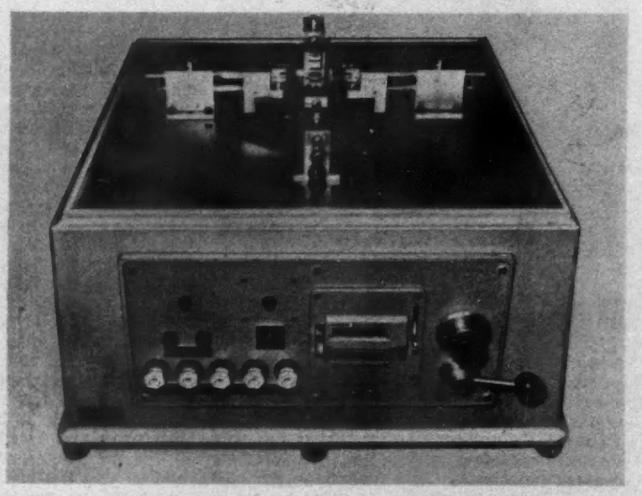


Fig. 10—Biaxial stress tester for elastic specimens such as rubber—AGFA-Physik

shows a biaxial testing machine for determining the fatigue resistance of rubber and plastic membranes. These are subjected to alternating tensions at right angles to one another.

Rhewum Rheinische Werkzeug- und Metallwarenfabrik G.m.b.H.

On the stand of Rhewum Rheinische Werkzeug- und Metallwarenfabrik G.m.b.H. were exhibited examples of this firm's sonic sifting machines which utilise current at the mains frequency to generate directly on the screen a vibration of 100 c/s, together with strong harmonics. This mechanical excitation facilitates the sifting and prevents binding even with materials which tend to clog strongly. A sonic filtration machine has a rectangular filter surface which hangs slack between one supporting edge, which is fixed and the opposite edge, which is electro-mechanically vibrated. The resulting waves carry the filter cake over the fixed edge, and in doing so substantially remove moisture. The machine, it is stated, can be applied to jellies or slurries, e.g. in effluent purification.

Evans Electroselenium, Ltd.

A blood counter exhibited by EEL Evans Electroselenium, Ltd., Halstead, Essex, uses a combination of photocell and electronic counter which can count accurately 5000 cells in ten seconds. Red and white cell counts can be carried out in two minutes compared with twenty minutes by the normal visual method. A flame photometer for the quantitative determination of alkali metals is stated to give readings at the rate of one per minute, accurate to within ± 1 per cent. A galvanometer filled with silicone oil was stated to be able to withstand the blow of a hammer and still give accurate readings.

Optische Werke Jena

New exhibits on the stand of Optische Werke, Jena, included an industrial spectroscope for the visible range with Leutwein photometer. The instrument is designed for the rapid analysis of metal parts which are placed directly on the spark stage. A three-prism spectrograph for emission and absorption spectrography from 3600Å to 10,000Å, is equipped with three easily interchangeable cameras and a powerful spark generator with capacities up to 24,000 pF and inductivities up to 5mH which is stated to give exactly reproducible discharges.

Optische Werke Jena has introduced a microscope for evaluating the photographic traces of nuclear particles, especially high-energy particles (Fig. 12). It is equipped for the accurate determination of depth, angles, and gaps. The instrument which is thermally insulated from the lamps and the observer, permits interferometric checking of the table and objective feeds. In order to minimise the subjective error, scales are read through the observation eyepiece, after switching over to "measurement." The results are recorded on a built-in tape recorder to avoid having to interrupt the observations.

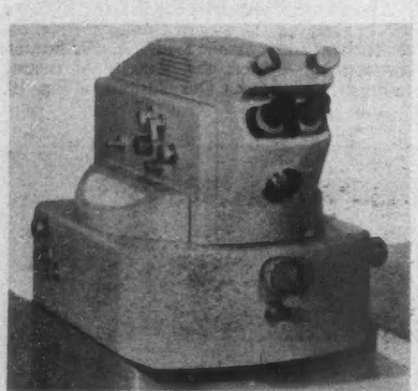


Fig. 12—Microscope for studying tracks of nuclear particles on photographic plates—Optische Werke, Jena

V.E.B. Werkstoffprufmaschinen

For fatigue tests on flexible specimens in the form of sheets or threads (paper, textiles, metal foil, wires, &c.), the firm V.E.B. Werkstoffprüfmaschinen, Leipzig, S3, introduced the flexure testing machine shown in Fig. 13, which carries out three tests simultaneously. Breakage of a specimen automatically stops its cycle counter.

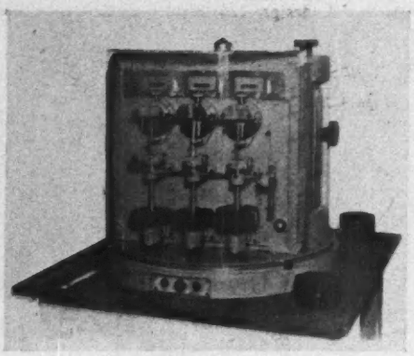


Fig. 13—Fatigue tester with three positions for flexure tests of thread specimens—V.E.B. Werkstoffprüfmaschinen

Construction and Dock Cranes

Our accompanying illustration shows a group of cranes for use on building sites, shipbuilding and dock work, as exhibited by Norddeutsche Schrauben- und Mutternwerke A.G., Peine, at the recent German Industries Fair at Hanover. The largest crane is designed for work on very tall buildings over 300ft high. This slewing tower crane has as its main driving position, a fully-enclosed cabin right underneath the jib joint. A second position is half-way up the main tower, and is also enclosed. The cranes can also be fitted with a wireless remote control, as was demonstrated at Hanover. This enables the driver to control the crane from any point on or near the building so that he can place himself in the best position for surveying the site of operation. Fully automatic overload safety devices are fitted which limit the permissible load in every position of the crane jib. The design of the crane is stated to be such that it can be transported from site to site without dismantling.

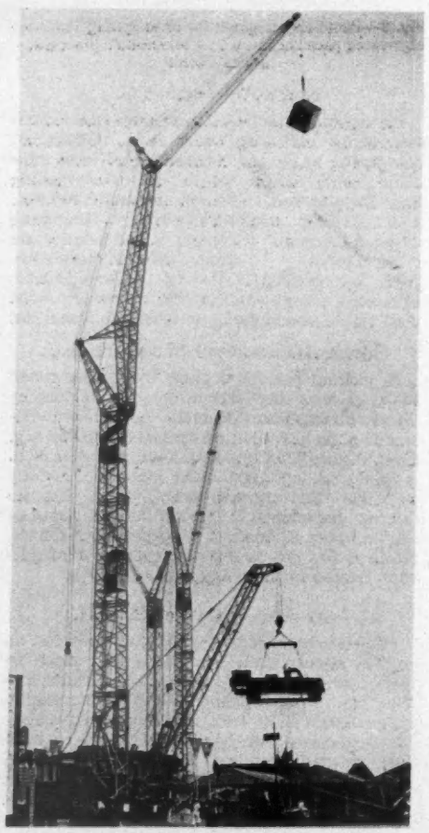
The hoisting speed of the "Model 921" crane, with loads up to 6620 lb, is 230ft per minute, and with higher loads, up to 129,000 lb, 111ft per minute. The slewing speed is 0·7 r.p.m., and the travelling speed 128ft per minute, while derricking from 15 deg. to 75 deg. takes about one minute. The hoisting motor has a power of 50 h.p., the four travelling motors each 10 h.p., the luffing motor 31 h.p., and the slewing motor 5 h.p., giving a total of 93·7kW. With a construction weight of about 61 tons, the crane carries about 41·5 tons of gravel ballast. The shorter crane shown in the illustration is one of the firm's specially designed portal cranes for shipbuilding and dock work; they are constructed in six sizes with lifting capacities from 20 to 80 tons.

It is two years ago since Norddeutsche Schrauben- und Mutternwerke A.G., Peine, installed the first remote control in a tower crane in order to make it possible to control the crane from the top of the building, especially in cases where the building was higher than the upper driving cabin within the crane. The remote control desk was connected with the main switch box in the crane by a thirty-six-core cable and thirty-six sliprings. Four control motors were used to turn the four cam-operated control drums for the four different crane movements. This motor-control system—as opposed to a contactor system—had the advantage that, in case of any trouble on the remote control, the crane could still be operated by turning the hand-wheels on the control box.

The new wireless remote control was designed and built by Hartmann and Braun A.G., Frankfurt/Main, on the basis of Peine development work. It avoids the disadvantage of the cable connection to the remote control desk and offers to the crane driver an unlimited mobility on the building site. The view on the working area is further improved and, therefore, the efficiency and the safety of the crane are considerably increased.

The control is based on the frequency-code-system. A portable v.h.f. transmitter by C. Lorenz A.G., Stuttgart-Zuffenhausen, emits an ultra-short wave on which thirty-six different audio-frequencies ranging between 300 c/s and 900 c/s can be superimposed. Each one of these frequencies corresponds to one control pulse. The receiver contains thirty-six relays which are actuated by the corresponding frequencies. After amplification, the control current switches the motors, which then turn the cam-control drums in the main switch box. The thirty-six audio-frequencies are selected so that they can never interfere with one another, although five to twelve control pulses can be transmitted simultaneously.

Besides the four crane movements, the following can be remote-controlled simultaneously and independently from each other: the warning horn, the slewing brake and the signal lamp for the second crane driver in the lower driving position of the crane, advising him to take over control. The control switches have built-in deadman's buttons, so all movements of the crane are automatically stopped if the crane driver on the building ceases to operate the controls.



Group of construction and dock cranes

Swedish Extrusion Press

AB Svenska Metallverken has over the past five years been engaged in an expansion programme at its Finspong branch, involving a sum of Kr.40,000,000 (£2,760,000). This plant specialises in semi-manufactures of aluminium alloys. The last stage of this expansion scheme, the acquisition of an extrusion mill for heavy girders and spars, and the building of a new pressing workshop, trebling the previous capacity, has just been completed. The new extrusion press has a capacity of 3500 tons and can take a maximum die section measuring 12·6in in diameter.

Tape Control System for Machine Tools

BY OUR AMERICAN EDITOR

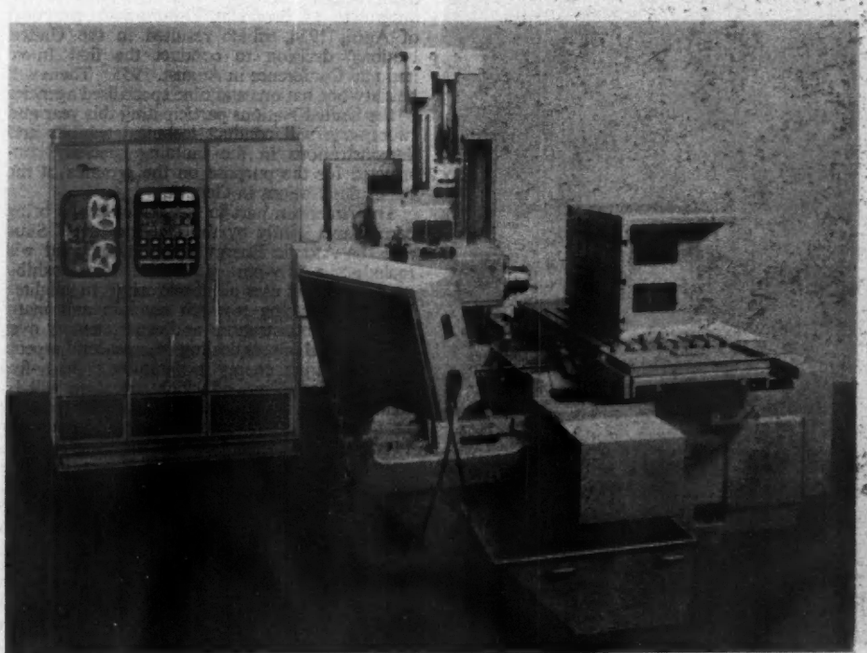
THE Bendix Aviation Corporation, of Detroit, Michigan, has developed a numerical control system for automatically controlling machine tools. The tape control system provides a precise, versatile method of "automating" machine tool cutting functions. Significant reductions in production costs are achieved with this system, which uses coded punched tape to control all machine motions. The parts produced by tape-controlled machine tools are extremely accurate and require a minimum of inspection operations. Built-in quality control devices in the form of automatic error-detecting circuits and continuous digital feed-back controls automatically shut down the machine if any malfunction is detected or adjust motions if errors occur. Excellent surface finishes are achieved with the system because the cutting tool is moved in a smooth, calculated, continuous path at all times. Automatic roughing and finishing cycles can be coded into the tape to provide for final skin cuts.

Although the Bendix system provides for automation of the highest order, it is extremely flexible. The machine tool operator can manually override the machine feeds within a range of from 20 to 100 per cent of the programmed feed rates. Either "continuous-position readout" or "inching" controls can be provided to facilitate tool changes and machine set-up. The continuous-position readout controls provide immediate reference points for the operator without the necessity of returning to the original set-up point. Inching controls allow the operator to stop the machine, withdraw the cutter spindle, change the tool, return to the machining position and continue under tape control without loss of synchronisation. An excess error shut-off in the machine control unit automatically shuts off the machine if electronic or mechanical errors occur in excess of an adjustable predetermined amount. The machine control unit allows the inversion of axes. Symmetrical right and left-hand parts may be cut with the same tape.

The Bendix tape control system is designed to obtain minimum maintenance and down time. Panel lights indicate trouble sources when excess error shut-down occurs. Standard plug-in electronic packages can be quickly and easily interchanged or replaced. Preventive maintenance is provided by using a marginal test technique to pick out electronic packages having marginal life before a workpiece is mounted in the machine. When a machine tool of the single-tool milling or contouring type is equipped with the system, a truly versatile machine for short run production of a wide variety of parts is provided. Change from one part to another is a matter of clamping the workpiece, installing the proper tape, mounting a cutter and positioning the cutter to the initial position. The accompanying illustration shows a Pratt and Whitney model "C" Keller milling machine with automatic control by the Bendix numerical control system at the left.

The Bendix system uses a simple punched plastic-coated metallic tape that is rugged and durable. This economical tape is quick and easy to prepare with a minimum of equipment and skilled personnel. A typical part requiring one hour of machining may be controlled with 100ft of tape. The photo-electric reading of the punched tape provides a fast, easy, reliable method of identifying the absence or presence of a hole. Dirt, skewing, splices, machine stops or starts, humidity, temperature changes and tape speed have minimum effect on punched tape. The tape is immediately usable on the machine as-punched and requires no conversion to another form.

The Bendix system can be adapted to a wide variety of milling, turning, jig boring and drilling machines. It is ideally suited to the machining of intricate three-dimensional parts containing pockets, flanges, tapers, contours or grooves. Contour turning operations on turbine blades or intricate cams can be performed by the system. Moulds, forging dies and stamping dies can be economically produced on Bendix tape-controlled machine tools. Aircraft parts, such as integral skin panels, spars and forged fittings are also ideal applications. A Bendix tape control system is a complete "package," including a tape preparation unit, a machine control unit, and compact servo drives and feed-back controls that operate the machine tool. One tape preparation unit consisting of a process tape perforator, a computer, an auxiliary magnetic tape storage unit and a control tape perforator will provide all the tape preparation facilities for a multiple-machine operation. A machine control unit, consisting of a hydraulic power supply, electronic machine control unit, servo drives, and feed-back units, is provided for each machine tool.



Bendix tape control system applied to Pratt and Whitney model "C" Keller machine

In applying the system to a machine tool a numerical drawing for the operation is first prepared, with the dimensions given as rectangular co-ordinates from two *X* and *Y* axes that intersect at a selected reference point. The third *Z* axis appears as a point at the intersection of the axes. A process sheet is then compiled, based on the co-ordinate dimensions from the numerical drawing. These dimensions are listed vertically in the sequence in which they will be machined, beginning with the set-up point in the upper left-hand corner. Each digit on the process sheet represents one row of holes on the process tape when converted. Different digit groups on the process sheet are separated in typing by depressing the "tab" key on the typewriter. Different lines are separated by pressing the "carriage return." Depressing keys in the typewriter causes coded characters to be punched in the tape which synchronise the tape with the stored programme in the computer.

The computer automatically converts the process tape information to a binary code for the control tape and offsets the tool centre from the actual part size. The control tape is punched in "blocks." Each block controls the machine in a straight line path from one point to the next. Only one block of information is required for any straight line cut. Curves are cut by the straight line approximation method to any desired accuracy within the scope of the machine tool itself. The interpolation of curves is performed by the computer. Command information on the tape consists of the binary numbers corresponding to the number of command pulses that must be delivered to each axis in order to drive the cutting tool along a straight line from the initial point to the next specified point. Additional information specifying the feed rate is also punched on the tape, and this governs the rates at which the command pulses are delivered to the servo units.

The photo-electric tape reader senses the holes in the tape. One block of information from the control tape is received by the electronic buffer unit and stored. The active storage unit receives information from the buffer storage and supplies it to the decoder as required. Coded digital information on the control tape is changed to command pulses by the decoder. Each pulse commands an increment of travel. These pulses serve as input to the servo units for the machine lead screw hydraulic motors. A number of pulse generators known as "quantisers," which are driven by the machine lead screws, produce electrical signals as the screws rotate. Signals from the quantisers are converted into feed-back pulses, each of which corresponds to the same amount of travel as a command pulse. The error registers keep a running count of the difference between the number of command pulses and the number of feed-back pulses. This error count is converted to a proportional voltage which is received and amplified by the servo amplifier. The output from the servo amplifier drives the hydraulic servo valve. This valve, which is mounted on the end of the motor, meters the flow of oil from the constant-pressure oil supply to the hydraulic motor.

The ultra-precision movements possible with the Bendix tape control system require that similar precision be incorporated into the machine tool if maximum work accuracy or finish is to be achieved. Machine tools currently operating may require some reworking to adapt the system and provide high accuracy. Machine tool builders can make optimum use of the system by planning for its inclusion at the machine design stage. The system provides for an infinite number of feeds within a wide range in conjunction with a rapid traverse feed.

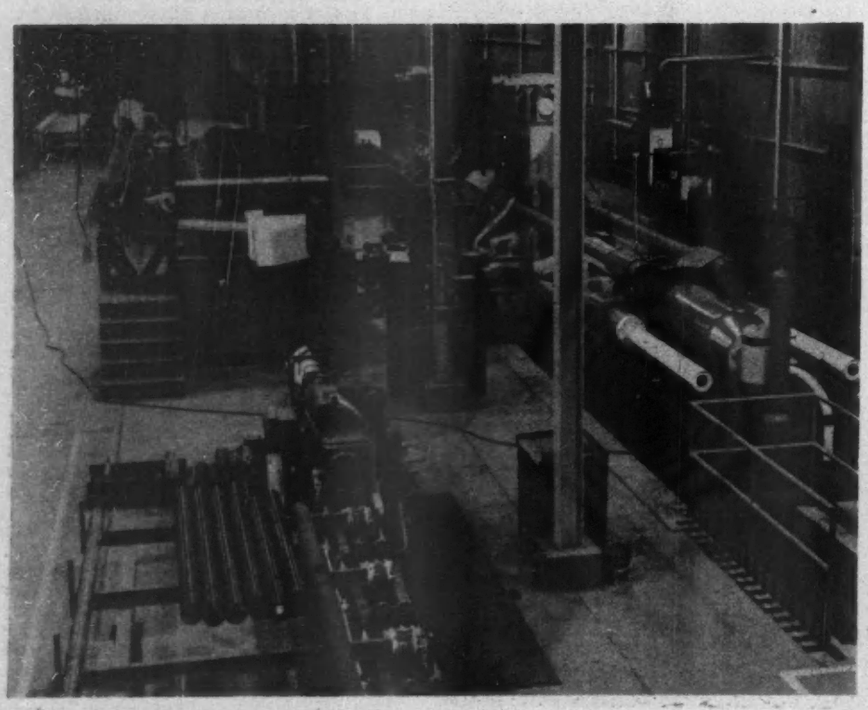
Hot-Extruded Cold-Drawn Steel Sections

MANY interesting applications of hot extruded, cold drawn steel sections were developed recently by the Jones and Laughlin Steel Corporation, of Pittsburgh, Pennsylvania. This firm has specialised in the manufacture of such custom-made sections made of carbon steels. With the introduction of glass some years ago as the medium for lubricating the die, hot extruding of steel became practical. Through intensive study and experimentation, and the establishment of careful production controls, the process of extruding steel at Jones and Laughlin has now become highly uniform. The physical properties of extruded steel sections are frequently superior to those of other wrought forms. They normally have a high order of homogeneity, accompanied by less directionality than rolled sections. Moreover, the transverse properties are virtually equal to the longitudinal properties. Internal quality is excellent and the extruded surfaces are usually superior to those that are rolled. When the extruding operation is followed by cold drawing, the traditional advantages of the latter process are imparted to the extruded product, including exceedingly close size accuracies. Consequently, machining operations on the part of the customer to secure a finished product are seldom required. Usually, the customer merely saws the extrusion to the length required for his needs. With all its versatility, the hot extrusion process by itself has some practical limitations; for example, extremely sharp fillets, thin fins and narrow deep slots introduce complications. However, by combining the hot extruding and cold drawing processes, one can produce steel sections of exceptionally complicated design.

Sections so complex that rolling is impossible can be produced economically by the hot extrusion process. Therefore, parts requiring the properties of steel, but formerly considered impractical, can now be hot extruded as a matter of routine. Moreover, a single extrusion can, in many instances, replace parts previously made by costly joining operations. Extruded sections can also often substitute for parts made at greater cost by casting, forging or machining from bar stock. Since the cost of dies is small when compared to the cost of setting up a rolling mill, the use of steel extrusions, even of simple and rollable shapes, is economical and advisable when small quantities are required. For this reason, the extruded steel sections are also suitable for pilot assemblies and experimental work. Extruded sections are often the answer when small quantities are needed quickly, because die making and setting up the extrusion press requires much less time and cost than procuring rolls and setting up a rolling mill. Hot extrusion is also the answer to securing sections in materials that previously were impossible to work as intricate shapes. In this category are such materials as titanium and zirconium alloys. Here extrusion, followed by cold drawing, will allow the user substantial savings in material and machining costs. Most important, hot extruded sections, when cold drawn, are produced to extremely close tolerances representing virtually a finished part, thereby saving both the time and cost involved in machining operations.

The firm's extruded and cold drawn sections are accurate to a tolerance generally accepted for conventional cold drawn bars and flats. The surface finish of the extruded and cold drawn bar is equal to the conventional cold drawn bar or flat. The company can extrude shapes measuring up to 3in across the extremes. At present, the extrusion of shapes weighing less than $\frac{1}{4}$ lb per foot, or approximately the same weight per foot as a $\frac{1}{4}$in round, is not considered feasible. The extruding and cold drawing process tends to improve the mechanical properties of a given section. The properties of an extruded bar are equal to or better than those of a rolled section having the same chemistry. Because of rapid billet heating and a controlled atmosphere in the induction heating unit, extruded sections are practically free from surface decarburisation; an important advantage where subsequent heat-treatment is required. Because extrusion die costs are relatively low, it is feasible to produce extruded sections in small quantities. In typical cases, a manufacturer can avoid high expenditures for capital equipment during the product development stage by using a special extruded shape to obtain an initial quantity quickly for pilot models. After design modifications are made, production orders can be placed and work started without delays. The firm has furnished extrusions in quantities as small as 80 lb to more than 50,000 lb.

The extrusion process commences with hot rolled 4in or 5in bar stock which is received in mill lengths. Each billet is cut to the required length, 6in minimum to 20in maximum. It is then heated to the extrusion temperature in a "Magnethermic" induction furnace. After heating, the billet is rolled through powdered glass, which serves as a lubricant. A glass disc is also placed between the billet and die in the press container and acts both as a lubricant and insulator between the die opening and the extruded product. The billet is extruded in a "Loewy" 1000-ton horizontal hydraulic press, shown in the right part of the accompanying illustration. Actual extruding requires but a few seconds, and under normal conditions the extruded bar will leave the press at the rate of approximately 30ft per second. Following extruding, the bar passes over a cooling bed, reaching handling temperature by the time it arrives at the "Loma" 50-ton hydraulic stretching and detwisting machine. After the bar is detwisted and straightened, which allows for an initial stretch of 2 per cent, it is given an additional 2 per cent stretch to set the bar in the extruded state. Before the extruded bar is cold drawn, it is shot blasted in a "Wheelabrator" machine to remove mill scale and accumulated glass. Then follows cold drawing, and final straightening is accomplished by hand bumping.



Steel extrusion plant at Jones and Laughlin, with 1000-ton extrusion press, cooling bed and 50-ton stretching and detwisting machine

Geneva Conference on Peaceful Uses of Atomic Energy

PLANS for a comprehensive United States exhibit at the United Nations Second International Conference on the Peaceful Uses of Atomic Energy at Geneva next September have been announced by the Atomic Energy Commission. The exhibit will encompass the whole range of peaceful uses and will include actual operating devices being utilised by scientists in their research efforts to harness the forces of thermonuclear energy. The conference is the outgrowth of President Eisenhower's proposal of April, 1954, which resulted in the United Nations' decision to conduct the first International Conference in August, 1955. There will be sixty-one nations and nine specialised agencies of the United Nations participating this year and twenty-one will conduct technical exhibits and demonstrations in the building specially constructed for the purpose on the grounds of the Palais des Nations in Geneva.

The American part in the conference is being carried out jointly by the Department of State and the Atomic Energy Commission, and will include: a fifty-part general technical exhibit on the peaceful uses of atomic enegy, highlighted by two operating research reactors and many research demonstrations and experiments; over 700 technical papers dealing with peaceful aspects of the atomic energy programme; forty-five new technical films, of which seventeen will be made available to the United Nations for showing at the Palais des Nations, and the remaining twenty-eight shorter films or vignettes will be shown as part of the United States exhibit; a technical information centre in which will be a comprehensive display of the books and periodicals on atomic energy published in the United States.

The controlled thermonuclear reaction exhibit will show a number of experimental devices such as are used in the U.S. laboratories engaged in fusion research. These devices will be in actual operation, with the demonstrations being conducted for the most part by scientists who are carrying on experiments in this field in the United States. The fusion exhibit will be essentially a

status report on the principal research paths presently being followed at four U.S. laboratories —Los Alamos Scientific Laboratory, Los Alamos, New Mexico ; University of California Radiation Laboratory, Berkeley and Livermore, California ; Princeton University's Forrestal Research Centre, Princeton, New Jersey ; and Oak Ridge National Laboratory, Oak Ridge, Tennessee. Other elements of the technical exhibit fall into three major categories—the physical sciences, the life sciences, and nuclear reactors. Three operating laboratories will highlight the life sciences section—a health and safety laboratory which will be used to monitor the United States Exhibits, a radiochemistry and isotope laboratory, and a laboratory to demonstrate carbon-14 labelling techniques. In the reactor section there will be two working reactors—an "Argonaut," the 10kW training reactor developed by the Argonne National Laboratory, and "Triga," a training, research and isotope-producing reactor, which was developed by the General Atomic Division of the General Dynamics Corporation. There also will be a full-scale model of the 38ft-high pressure vessel and core of the Shippingport power reactor and models of other civilian reactors.

At the invitation of the Commission, industrial nuclear scientists and engineers and staff members of hospitals and private educational and scientific institutions have prepared 1553 abstracts of technical papers proposed for presentation at the conference. Over 700 papers will be submitted to the United Nations, and will be accepted for inclusion in the proceedings. Approximately 160 of these will be recommended for oral presentation at the conference.

Large Contouring Lathe for Missile Components

A LATHE designed for precision contour turning, boring and facing of missile nose cones, nozzles, motor cases, air frame sections, hemispherical and elliptical domes and other large thin-walled and fabricated parts, has been developed by the Monarch Machine Tool Company, of Sidney, Ohio. The new lathe is illustrated in the accompanying photograph and has been called the "Missile Master." It was specifically designed to meet the requirements of the missile industry for large swing capacity, ultra-close machining tolerances and critical surface finishes. The clearance diameter of the machine is 85in with a 67in cross slide swing. Bed lengths are available up to 300in between centres, in increments of 48in. The lathe is equipped with the Monarch swivelling air-gauge tracer contouring system, which is already widely used by missile and aircraft contractors.

Since missile components are thin-walled and, hence, relatively light in weight, heavy stock removal, as understood in general manufacturing practice, is not required. As a result, a 25 h.p. drive motor is fitted and is more than adequate for all recommended work. Large diameter workpieces require low spindle speeds. This is achieved on the "Missile Master" through the use of a face plate drive headstock design. The driving force is applied to the face plate far out from the work axis, through an auxiliary pinion and internal ring gear mounted on the rear of the face plate assembly. The speed range through the face plate drive is sufficiently broad to handle a wide diameter range. For example, a surface speed of 150ft per minute can be maintained constant over a 19in to 71in diameter variation, using only the highest speed setting in the eight-speed face plate drive range. Any one of the seven other speed settings gives an equally wide ratio for lower diameter work.

The eight speeds available using the face plate drive are 1¼ to 30 r.p.m. Driving power for the sixteen speeds in the high speed range, 1¼ to 250 r.p.m., is applied directly through the spindle. This provides speeds high enough for the efficient turning of small diameters. Since the main motor of the lathe is a 4 : 1 variable speed d.c. drive, each of the twenty-four speed settings also is infinitely variable 4 : 1. Successive ranges have considerable overlap. The standard face plate is 50in in diameter. An 80in diameter face plate is available on special order. The main drive motor is floor mounted and drives the spindle through multiple "V" belts. A special interlock is provided to prevent the simultaneous engagement of the face plate and direct spindle drives.

The heavy-duty, two-speed tailstock of the machine is equipped with a 7½in diameter hardened and ground alloy steel spindle. It is provided with an anti-friction bearing mounting for a live tailstock centre and an outside spindle adapter for drilling operations. The two speeds of travel are provided through a gearbox, with the fast speed used for normal positioning purposes and the slow speed used mainly for drilling. Control is by means of a conveniently situated handwheel on the tailstock front. Complete lubrication of the unit is effected by its own automatic lubrication system which also feeds oil to the bed ways below the tailstock.

The anti-friction bearing gearbox of the machine is totally enclosed and automatically lubricated. A range of forty-eight commonly used threads and feeds is provided. The range of threads per inch is 2 to 112 ; the range of feeds per revolution is 0·00075in to 0·0421in. An interesting aspect of the apron is variable speed power rapid traverse of both the carriage and cross slide. This provides rapid tool positioning, quick retraction and fast carriage return. Movement is hydraulically controlled and infinitely variable and is so sensitive that manual traverse by means of the apron or cross feed handwheel is virtually eliminated. Longitudinal and cross traverse can be engaged simultaneously. Oil to the carriage bed ways and to the cross slide is supplied by the automatic lubrication system. Attached to the apron of the lathe is a treaded operator's platform. It extends forward from and to each side of the apron, giving ample space for the operator to stand on either side of the slide during set-up. In addition, the operator can ride with the carriage to observe tool action during the cut.

The design of the 54in wide bed is based on a new concept, using a solid top wall sloped toward the rear. This makes chip removal easy from the rear and also directs coolant flow toward the back of the machine. Extra-wide flat ways support the carriage. The front guide way consists of a hardened rectangular section bolted to the bed and gibbed to the carriage to obtain accurate carriage guidance along the bed ways. The tailstock is supported by a V-way at the front and a separate flat way at the rear. Automatic travelling rod supports are supplied on all machines.

The extra wide T-section carriage of the machine is supported by a large flat guide way both at the front and the rear of the bed. Front carriage wings of more than usual proportions are each provided with a treaded top. As a consequence, the operator may stand safely on either of the wings to facilitate set-up. Special cross feed gearing, within the carriage, is employed for varying the ratio between longitudinal and cross feed, in order to increase the diameter change which may be turned at one setting. Because of the geometry of many large missile parts, this is considered an important feature.

To reproduce complicated missile contours with extreme accuracy the lathe is equipped with the Monarch swivelling air-gauge tracer system. The swivelling slide is of very rugged design and has the same extra width as the carriage. This slide may be set at any point between, parallel to and perpendicular to the work centre-line for template-controlled turning, facing or boring work. Power for actuating the tracer slide is supplied by the lathe hydraulic system. Tracer stylus pressure against the template is only about 5 oz. This eliminates all appreciable template wear and precludes any need for hardening. The template itself is mounted atop the extra-wide bed, permitting tracing with a template diameter variation of as much as 35in. This is significant, since the nature of missile work requires greater diameter variation than has been necessary on tracer lathes heretofore. The templates are aligned against and clamped on movable supports which are located at appropriate intervals. For facing operations, an across-the-bed template support is furnished.

The tool adjusting slides are mounted at right angles to each other on the air-gauge tracer slide. The purpose of the lower slide is to provide longitudinal adjustment between the tool and the template when setting up the lathe for a new workpiece. The upper tool slide functions in the usual manner as the cutting tool mount.

Particularly on facing operations but also when turning parts having an extreme diameter variation, constant surface cutting speed control is essential for the maintenance of a high surface finish and for obtaining practical tool life. This kind of speed control is available on the "Missile Master," for operation in connection with the standard 4 : 1 variable speed drive of the machine. Speed control templates, which actuate an electrical reactor are mounted longitudinally for turning and boring operations and across the bed for facing work. A range of eight extra low spindle speeds is also available for use in thread milling. Here again, face plate drive is essential. Through a separate gear train atop the headstock, a driving pinion is engaged with the face plate internal ring gear, giving extra low range speeds from $^{1}/_{32}$ to ¾ r.p.m. Employing 6in circular feed in inches per minute, the lathe is capable of milling threads on any missile component between 2½in and 67in in diameter.

Monarch "Missile Master" contouring lathe for machining of missile components

Personal and Business

Appointments

MR. G. E. SUGDEN has been appointed sales manager of Ketay, Ltd.

MR. A. W. FIELD, A.M.I.Mech.E., has been appointed deputy managing director of Mawdsley's, Ltd.

MR. J. E. HINDE has been appointed organisation and methods officer in the Metal Industries Group of companies.

MR. BRIAN SKELTON has been appointed depot manager of the Cambridge depot of Kerry's (Great Britain), Ltd.

DR. W. ANGUS MACFARLANE has been appointed managing director of the National Industrial Fuel Efficiency Service.

DR. C. J. DADSWELL has been elected chairman of the British Steel Founders' Association, in succession to Mr. G. M. Menzies.

MR. F. L. DONNISON, A.M.I.Mech.E., chief engineer, has been appointed a director of Hick, Hargreaves and Co., Ltd.

THE RESEARCH ASSOCIATION OF BRITISH RUBBER MANUFACTURERS has announced the appointment of Dr. W. F. Watson as its director.

THE PLASTICS INSTITUTE announces that Dr. J. C. Swallow, A.M.I.Chem.E., has been elected president, and Mr. J. V. Crossley, chairman of council.

THE GOODYEAR TYRE AND RUBBER COMPANY (GT. BRITAIN), Ltd., has announced that Mr. W. J. Gaffney, has been appointed chief engineer for all its production plants in Great Britain.

THE CLAN LINE STEAMERS, Ltd., has announced that Captain A. J. Hogg has been appointed commodore of the Clan Line fleet in succession to Captain H. J. Anchor, who has retired owing to ill health.

THE MINISTRY OF SUPPLY has announced the appointment of Major-General L. E. Cutforth as director-general of inspection in succession to Sir Thomas Barnard, who is retiring from the public service.

DR. J. B. HIGHAM has been appointed to the new post of head of technical development by Pilkington Brothers, Ltd. He will be responsible for the creation of a centralised department to co-ordinate and expand technical development in all the company's works.

METROPOLITAN-CAMMELL CARRIAGE AND WAGON COMPANY, Ltd., has announced that Mr. F. A. Pope has been appointed a director. Mr. J. G. James, commercial manager, and Mr. W. Scott, chief accountant, have been appointed special directors.

THE BRITISH GOVERNMENT has announced the appointment of Mr. Arthur Harry Tandy as head of the U.K. delegation to the High Authority of the European Coal and Steel Community and British representative with the Commission of the European Atomic Energy Community (Euratom).

THE INSTITUTE OF WELDING has announced that Mr. J. Strong has been elected president for 1958–59 in succession to Sir Charles Lillicrap. Mr. A. Clifford Hartley, M.I.C.E., M.I.Mech.E., Mr. G. Roberts, M.I.C.E., and Mr. E. Seymour-Semper, M.I.Mech.E., have been elected vice-presidents.

INDIAN STEELWORKS CONSTRUCTION COMPANY, Ltd., announces that Mr. R. J. Barritt, managing director, is to resign as from September 1, now that the organisation of the company is fully established. He will continue as a consultant. Mr. W. S. Hindson, chief engineer, has been appointed managing director.

WADKIN, Ltd., has announced the following reconstruction to its board of directors :—Mr. Charles H. Morris has been appointed managing director in succession to the late Mr. L. Austin. Mr. S. Radcliffe, A.M.I.Mech.E., and Mr. W. L. Simms, M.I.E.E., have been appointed assistant managing directors, and Mr. J. H. Devonald has been appointed a director.

THE COMITE INTERNATIONAL RADIO-MARITIME announces the appointment of Ir. W. D. P. Stenfert, the managing director of Radio Holland N.V., as president, and Mr. H. Thorpe Woods, the managing director of the International Marine Radio Company, Ltd., and Herr W. E. Steidle, director of Deutsche Betriebsgesellschaft fuer drahtlose Telegrafie m.b.h., as vice-presidents.

BRITISH RAILWAYS (London Midland Region) has announced that Mr. J. F. Harrison, M.I.Mech.E., M.I.Loco.E., Chief Mechanical and Electrical Engineer, has now assumed responsibility for the overall direction of all mechanical and electrical engineering work of the region, including the chief mechanical and electrical engineer's department and the carriage and wagon engineer's department, as well as the technical aspects of motive power and road motor engineer departments.

Business Announcements

MR. E. B. WASTELL, general manager of the Selby, Yorks, works of John and E. Sturge, Ltd., has retired at the age of sixty-five.

ALUMINIUM (CANADA), Ltd., has moved to Aluminium Canada House, 30, Berkeley Square, London, W.1 (telephone, Mayfair 9721).

HUDDERSFIELD TRAINING COLLEGE states that as from July 28 its address will be Holly Bank Road, Lindley, Huddersfield (telephone, Huddersfield 9580–1).

AIR FRANCE states that its main London ticket office has been transferred from 52–53–54, Haymarket, to Air France Building, 158, New Bond Street, London, W.1.

NATIONAL INSPECTION COUNCIL FOR ELECTRICAL INSTALLATION CONTRACTING is now located at Aldine House, 10–13, Bedford Street, London, W.C.2 (Covent Garden 1163/4).

CAWKELL RESEARCH AND ELECTRONICS, Ltd. (formerly A. E. Cawkell, Electronic Engineers), has moved to Scotts Road, Southall, Middlesex (telephone, Southall 3702/5881).

CRAVEN BROTHERS (MANCHESTER), Ltd., announces that Mr. W. W. MacArthur, works director, has decided to retire from full-time business activity and has resigned from the board of the company.

THE BOARD OF TRADE has announced that the Earl of Halsbury will retire from the position of managing director of the National Research Development Corporation on March 31, 1959, to take up another appointment.

KELVIN AND HUGHES (INDUSTRIAL), Ltd., states that its administrative offices are to be moved from 2, Caxton Street, Westminster, London, S.W.1, to Empire Way, Wembley, Middlesex (telephone, Wembley 8888).

WESTOOL, Ltd., St. Helen's Auckland, County Durham, and A. P. BESSON AND PARTNER, Ltd., Hove, have formed an association. Westool will act as sole selling agent for all relays, micro-components and sensing devices manufactured by A. P. Besson and Partner, Ltd.

J. W. ROBERTS, Ltd., states that on August 2, its headquarters will be moved from Armley, Leeds, to Chorley New Road, Horwich, Bolton, Lancashire (telephone, Horwich 840). The Ferobestos department, Chorley New Road, Rostock, Bolton, and the general sales department, Victoria Chambers, South Parade, Leeds, 1, will also move into the new headquarters on that date.

G. AND J. WEIR, Ltd., and CATTON AND CO., Ltd., state that they have decided to combine their foundry activities by forming a new company, Weir-Catton, Ltd., to acquire the capital of Catton and Co., Ltd., and the capital of The Argus Foundry, Ltd., a wholly owned subsidiary of G. and J. Weir, Ltd. It is hoped that the new company will be formed before September 30. Under the new arrangement the name of The Argus Foundry, Ltd., will be changed to Weir Foundries, Ltd.

Contracts

DUNLOP SOUTH AFRICA, Ltd., is supplying to the South African Railways 61,000 neoprene synthetic rubber pads for precast concrete sleepers. The pads are of "envelope" design and fit between the rail and the clips fixing it to the sleeper.

THE SOUTH EASTERN GAS BOARD has placed an order with the Woodall-Duckham Construction Company, Ltd., for the erection of a plant for the production of crude synthesis gas from a range of oil feed stocks and employing the "Shell Gasificaton Process," which is a gasification system with oxygen under pressure.

RICHARD COSTAIN (AFRICA), Ltd., has started work on the construction of the diversion weir and channel for the Kasama hydro-electric scheme. This scheme is the first of a series of schemes in the Northern Province of Northern Rhodesia. It is designed to cater for Kasama's need for the next ten years, and it is expected that electrical power will be available towards the end of 1959.

THE EASTERN REGION OF BRITISH RAILWAYS has announced the placing of the following contracts :—Thomas Fletcher and Co., Ltd., Mansfield, Notts, construction of a new railway to Bevercotes Colliery ; Metropolitan-Vickers G.R.S., Ltd., supply and installation of signalling equipment for East Coast main line widening between Greenwood–Potters Bar, and signalling equipment and automatic train control equipment, in connection with Barking flyover scheme ; Henry Lees and Co., Ltd., Motherwell, construction of one 200-ton electrically operated locomotive coaling plant at Mexborough.

COURTAULDS, Ltd., states that negotiations have been successfully concluded with Technopromimport, Moscow, for a contract to supply machinery for a factory which is being constructed in Russia. The factory will manufacture cellulose acetate yarn from Russian made raw materials. Some of the machinery will be fabricated in Courtaulds' workshops at Coventry ; some will be supplied by other United Kingdom firms to Courtaulds' requirements and specifications. Courtaulds, Ltd., has undertaken the responsibility for supervising the erection of the machinery and for putting the acetate yarn factory into production.

THE BRITISH TRANSPORT COMMISSION states that, as part of the recently accelerated programme of partial conversion to diesel traction on British Railways, orders have now been placed for 124 main line diesel-electric locomotives for mixed-traffic duties. A batch of forty complete locomotives of this kind is to be built by the Brush Electrical Engineering Company, Ltd., Loughborough, and the remaining eighty-four are to be erected in British Railways' workshops incorporating traction equipment supplied by The British Thomson-Houston Company, Ltd., Rugby. Deliveries of the locomotives and traction equipment will begin early in 1959. The Eastern Region is to have 106 of the 124 locomotives now ordered. The remaining eighteen units will be allocated to the North Eastern Region. All the locomotives will be in the 1000 h.p. to 1250 h.p. range, classified as Type 2 in the British Railways classification of main line diesel locomotives.

Miscellanea

OIL MIST DETECTORS.—Following successful extensive service trials at sea and Ministry of Transport approval of the Graviner/B.S.R.A. oil mist detector, manufactured by the Graviner Manufacturing Company, Ellerman Lines, Ltd., has decided to fit two oil mist detectors on three of its ships, namely, the "City of Port Elizabeth," "City of Durban" and "City of Exeter."

I.B.A.E. SCHOLARSHIPS.—The Institution of British Agricultural Engineers has awarded the Dunlop scholarship, presented by The Dunlop Rubber Company, Ltd., to Mr. Derek C. Farnes. Shell-Mex bursaries, presented by Shell-Mex and B.P., Ltd., have been awarded to Mr. Denis A. Sims and Mr. John B. Underwood. All three of these candidates are proceeding to the Essex Institute of Agriculture for the course of study leading to the final examination for the National Diploma of Agricultural Engineering in July, 1959.

MOTOR VEHICLE STATISTICS.—The June, 1958, *Monthly Statistical Review* of the Society of Motor Manufacturers and Traders, Ltd., shows that this country was, during the first three months of this year, the largest manufacturer of buses in the world, the second largest manufacturer of goods vehicles, and the third largest manufacturer of cars. Total production figures for the main producing countries for the three months were : United States of America, 1,459,577 ; Western Germany, 373,230 ; United Kingdom, 365,161 ; France, 287,863.

WINDSCALE NO. 1 PILE.—As forecast recently by Sir William Cook (see THE ENGINEER, July 11, pages 41 and 47), the United Kingdom Atomic Energy Authority has decided that it would not be worth trying to rehabilitate the damaged pile at Windscale plutonium factory. An announcement from the Authority states that the maximum of technical information that can be derived from examination of the core is, in fact, being obtained, and useful materials and equipment will be recovered. Some of the buildings are to be adapted for new uses, and the remainder will be sealed. Persons hitherto employed on the reactor are now working elsewhere at the Windscale establishment.

B.B.C. TELEVISION STATION FOR FOLKESTONE.—The B.B.C. has announced that its new low-power television transmitting station at Creteway Down, Folkestone, went into operation on Monday, July 14. Transmissions are at first on an experimental basis as the equipment, which is designed to work unattended, is of a new design recently developed by the B.B.C. for improving reception over limited areas where technical conditions are suitable for the use of this kind of station. The new station transmits in Channel 4 (vision 61·75 Mc/s, sound 58·25 Mc/s), and uses a directional aerial so as to provide the maximum signal strength in the town. The transmissions are horizontally polarised, and receiving aerials must be erected in a horizontal position. It is expected that good reception will be provided for some 40,000 people living in Folkestone, but at some low-lying points in the shadow of the cliffs the signal will be weakened by screening.

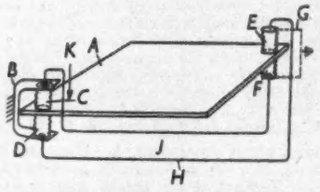
British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application: the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

SHOCK ABSORBERS

797,530. May 10, 1955.—Vibration Eliminating or Damping Mountings, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2. (*Inventors: Alan Mann and Bernard Roy Tuppen.*)

The invention relates to a vibration eliminating or damping mounting for a rigid body. The invention may be more clearly understood from the drawing, which represents diagrammatically a perspective view of a mounting for a rigid member or body *A* illustrated as a flat rectangular plate. In the drawing mountings at only two opposite corners are shown, but it will be appreciated that additional mountings in the other two corners will operate similarly. A fixed member attached to earth is shown at *B*, and between the fixed member and the member *A* are two oil-filled bellows *C* and *D* mounted one on each side of the member *A*. Similar bellows *E* and *F* are mounted on a fixed member *G* (shown dotted) at the opposite corner. Interconnecting bellows *D* and *E* and bellows *C* and *F* are two conduits *H* and *J* respectively. It will be appreciated that if there is no connection between bellows *C* and *D*, nor between *E* and *F*, when pressure is applied to the member *A* at, say,



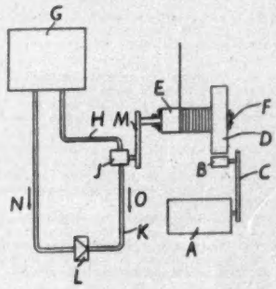
No. 797,530

the point *K*, it will move in a downward direction and liquid will be transferred from the bellows *D* to the bellows *E* to move the opposite corner down by a similar amount. It will be obvious, therefore, that if the member *A* is rigid, the whole of the member will move downward. If similar mountings are arranged also at the other corners, then pressure applied in a vertical direction at any point on the member *A* will produce a movement of the whole member in the direction of the applied pressure. In the simplest arrangement which has given satisfactory results, the member *A* would be supported by bellows *D* and *F* in the positions shown in the drawing with the bellows *B* and *E* transferred one to each of the other two corners and on opposite sides of the member, with the axes of all the bellows being parallel. If desired, rotation about a vertical axis could be prevented by an arrangement according to the invention, operating in the other plane, in addition to the plane already shown.—*July* 2, 1958.

CRANES AND LIFTING APPLIANCES

797,429. February 9, 1955.—Hoisting Apparatus, A.C.E. Machinery, Ltd., Porden Road, Brixton, London, S.W.2. (*Inventor: John Stewart.*)

The invention relates to hoisting apparatus and in particular to apparatus of the kind described and claimed in Specification No. 637,123. The object of the invention is to provide improvements in the arrangement designed to enable the descent speed of



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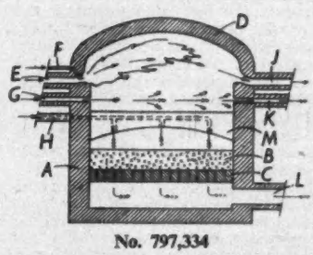
the hoist to be maintained under effective control throughout the descent of a load, or of an unloaded platform or receptacle. The arrangement according to the drawing includes a prime mover *A*, preferably an internal combustion engine, and a friction driving pinion *B*, driven from the engine through gearing *C*. This driving pinion is adapted to drive a friction wheel *D* fixed to the cable winding drum *E* of the hoist, the drum and wheel being mounted upon a shaft *F* journalled in eccentric bearings partial rotation of which moves the wheel into driven engagement with the pinion for operating the hoist to raise a load. During the descending movement of the hoist and while the cable is being unwound from the drum, the friction wheel *D* is disengaged from the pinion *B*, as shown, and the hydraulic braking arrangement according to the invention automatically comes into operation. This arrangement comprises an oil reservoir *G* connected via a supply conduit *H* with a hydraulic pump *J*. The pump is, in turn, connected to the reservoir via a return conduit *K* containing a valve *L*. The driving shaft of the hydraulic pump *J* is connected through chain and sprocket, gearing or other positive driving means *M*, to the winding drum spindle. The arrangement of these components is such that during ascent of a load a free flow of oil takes place through the hydraulic circuit in the direction of the arrow *N*, the valve *L* being constructed to give unrestricted flow in this direction. During the descending movement the direction of flow of oil is reversed as shown by the arrow *O* and the valve *L* imposes a load which opposes the flow and thereby controls the speed of descent.—*July* 2, 1958.

GAS-MAKING PLANTS

797,334. November 6, 1956.—Process and Apparatus for the Production of Combustible Gas, Societe de Construction D'Appareils pour Gaz a L'Eau et Gaz Industrials, 4, Place des Etats-Unis, Montrouge (Seine), France.

The invention relates to a process and apparatus for the catalytic cracking of hydrocarbons for the production of combustible gas in which the hydrocarbons for gas-making alone or mixed with steam and/or other oxygenated compound, are passed through a cracking chamber containing a catalyst. The apparatus in a practical embodiment comprises essentially a catalyst bed supported on a grid, and surmounted by a refractory wall and the surface of the catalyst are, below one another, the inlets and outlets for the heating fluids, the intermediary fluids, and, lastly, the gas-making fluids; below the catalyst is the outlet for the gas made. The drawing shows, in vertical section, the cracking chamber *A* and the catalyst bed *B* supported on a grid *C* the refractory radiating wall *D*, the inlets *E* for air for combustion of the heating fuel, the inlets *F* for the heating fuel, the inlets *G* for the intermediary fluid or fluids, the inlets *H* for the fluids used in gas making, the outlets



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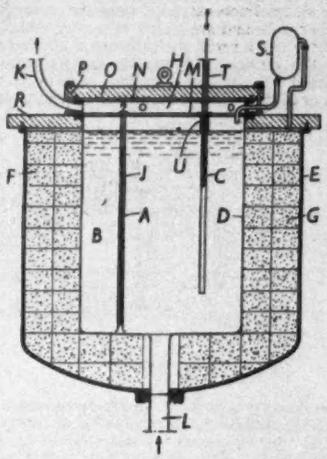
J for the heating gases, the outlets *K* for the intermediary fluid or fluids, the outlets *L* for the cracked gas, arrangements such as a refractory grid-like structure *M* to ensure good distribution of the gas-making fluids. The drawing shows the three main paths followed by the fluids:—Single arrows, heating fluids; double arrows, intermediary fluids; triple arrows, gas-making fluids. The catalyst may, if desired, be divided into two or more layers with the introduction of air between each layer so as to increase the temperature by partial combustion of the cracked products and thus impart additional heat to the catalyst. As in the case of a "Martin" furnace, checker-filled chambers can be connected with the inlets and outlets for the heating fluids and intermediary fluids and the direction of flow can be reversed periodically so as to recover sensible heat from the outgoing fluids. Any other apparatus for heat recovery such as heat exchangers, boilers and the like, may be added.—*July* 2, 1958.

NUCLEAR REACTORS

797,485. November 19, 1956.—Low Temperature Nuclear Reactors, The Allmanna Svenska Elektriska Aktiebolaget, Västeras, Sweden.

The drawing illustrates a nuclear reactor according to the invention only by way of example. The uranium rods *A*, the moderator *B* and the rods *C* for the control of the reactor, are accommodated within the reactor vessel *D* having a comparatively thin wall. This vessel is surrounded by a pressure vessel *E* of steel, in such a manner that there is a reflective space *F* between the vessels *D* and *E* for the reception of the reflector material *G*, such as graphite. The reactor vessel *D* is closed by a cover in the form of a vessel *H* for the heavy water collecting and heat transmission medium, which is sucked through tubes *J* past the fuel rods and flows through the collecting vessel *H*, the pipes *K*, the heat exchanger and returns through a pipe *L* to the reactor vessel. The lower ends of the tubes are open and their upper ends are fixed to the bottom *M* of the collecting vessel. The uranium rods are suspended from the cover *N* of the collecting vessel which is reinforced by a steel plate *O* which is attached by means of ring bolts *P* to a ring plate *R* forming the cover for the reflector space *F*. Above the heavy water level in the reactor vessel there is usually a cushion of inert gas, for



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instance CO_2 or He, which communicates with an expansion vessel *S*. The reactor vessel communicates with the reflector space *F* through the expansion vessel *S* so that the same pressure exists in the vessel and the space. The interstices existing in the reflector material *G* may be filled with heavy water. The control rods *C* are surrounded by tubes *T* closed at their lower ends and fixed at their upper ends to the cover of the collecting vessel. When the reactor vessel is opened the ring bolts *P* are unscrewed and the plate *O* together with the cover *N* is lifted. The tubes *T*, which are guided by sleeves *U* fixed in the bottom *M* and extending below the surface of the water, and the uranium rods *A* follow with the plate *O*. The invention has the advantages that the construction is simplified and the reactor vessel may be made so thin that neutron absorption in any appreciable degree cannot occur in spite of the comparatively high pressure.—*July* 2, 1958.

CONVEYORS

797,303. December 19, 1955.—Conveyor and Transmission Belts and Joints, Beltfasteners, Ltd., Wangye Works, Chadwell Heath, Essex. (*Inventor: Eric Harris.*)

The invention concerns improvements in or relating to conveyor and transmission belts and joints and means for making these joints, the joints in question being of the type in which fasteners or hooks are employed. An object of this invention is to provide an improved means for sealing the joint between the ends of a conveyor or transmission belt to preclude or reduce the passages of fines or dust through the joint and to protect the exposed edges of the belt ends by a means being capable of being readily applied without special equipment or tools. Referring to the drawing, the sealing member illustrated com-

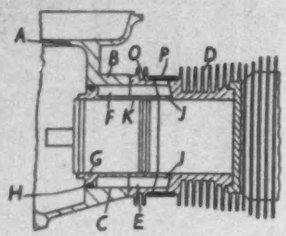
No. 797,303

prises a rectangular cross-sectioned strip *A* of a non-inflammable foamed polyisocyanate resin material, which is flexible and resilient, and a stiffening or reinforcing element *B* in the form of a rectangular strip of polyvinylchloride sheet bonded by a non-inflammable adhesive to one longitudinal edge of the strip. The belt joint is made in the usual way by clenching into each of the two belt end portions a set of spaced parallel fastening hooks. The substantially rigid reinforcing element *B* enables it to be inserted endwise easily into the belt joint without the use of equipment. The sealing strip is very resilient and efficiently fills the gaps or interstices between the fasteners or hooks. It is easily inserted into the loops of the fastening hooks before the hinge pin *C* is introduced and readily compressed by the hinge pin as it is inserted into the loops.—*July* 2, 1958.

INTERNAL COMBUSTION ENGINES

797,639. September 7, 1956.—TWO-STROKE CYCLE ENGINES, Ferdinand Porsche, responsible partner of Dr.-Ing. h.c. F. Porsche K.G., 25, Moritz-Horkheimerstrasse, Stuttgart-Zuffenhausen, Germany.

The invention relates to a two-stroke cycle engine provided with feed or delivery of the scavenging air into a scavenging-air chamber which surrounds the cylinder walls and from which the air passes over into the cylinder through slots or apertures controlled by the piston. According to the invention, continuations of the air inlet slots extend through the scavenging-air chamber walls and are closed by a removable clamping strip. As a result the slots are readily accessible from the outside and can be easily cleaned and machined. Furthermore, the cast parts of the engine block or of the cylinders may be simplified. Referring



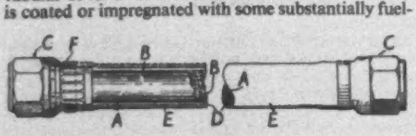
No. 797,639

to the drawing *A* is the crankcase of the engine with a collar-like projection *B* containing an aperture or bore *C*. An air-cooled cylinder *D* abuts against the projection *B*. The cylinder is provided with an annular pocket *E* which together with the aperture *C* of the crankcase *A* forms a scavenging-air chamber *F*. The scavenging-air chamber is sealed against the crankcase by a cylindrical collar *G* integral with the cylinder which extends into the bore *C* and which is provided with a seal *H* near the inner end. Slots in the cylinder walls are provided for the passage of the air into the cylinder space, which is supplied from a piston compressor or the like to the scavenging-air chamber *F*. Continuations of the slots *J* extend through the scavenging-air chamber wall *O* and are covered on the outside of the wall by a steel clamping strip *P* of known construction with the insertion of a heat-resistant seal, made of asbestos or the like. Upon removal of the strip *P* and of the insulating material the slots are laid bare and readily accessible from the outside for purposes of cleaning or machining and to empirically test the optimum size of aperture *J* for a given engine without having to dismantle the engine itself.—*July* 2, 1958.

PIPE COUPLINGS

796,584. November 29, 1955.—FLAME-RESISTANT FLEXIBLE HOSE ASSEMBLY, The Resistoflex Corporation, 39, Plansoen Street, Belleville, County of Essex, State of New Jersey, U.S.A.

The invention relates to flexible hose assemblies, more particularly hose lines for use on aircraft. The object of the invention is to provide a flexible hose assembly having increased fire resistance so that its functional life under actual fire conditions is greatly prolonged. As shown in the drawing, a tube *A* of polytetrafluoroethylene is preferably formed by the so-called paste extrusion process followed by sintering. This plastic is capable of withstanding temperatures somewhat above 500 deg. Fah. without deterioration. On this tube are one or more layers of reinforcing wire braid *B*. This hose is secured at its ends in fittings or coupling members generally designated *C*, preferably of steel and of the construction described in the co-pending Specification No. 777,668. An important feature of such a fitting is that the wire braid is anchored in the fitting independently of the tube, preventing blow-off even if the synthetic resin tube is softened or disintegrated by excessive heat. Over the entire hose is a flexible tubular cover *D* of woven or braided asbestos which is coated or impregnated with some substantially fuel-



No. 796,584

and oil-proof material such as one of the synthetic rubbers such as Buna or silicone rubber, as shown at *E*. This coating is applied also around the ends and on the inside of the tubing *D* so as to underlie the clamping means. The internal diameter of the tubing *D*, it should particularly be noted, is greater than the outside diameter of the outer wire braid cover *B* so that a substantial volume of air is enclosed between the hose and the asbestos cover. It will also be seen that tubing *D* is of such length as to cover the fittings *C* over the portions of it within which the hose is secured, leaving only the swivel nut portions exposed. The tubing *D* is tightly clamped on the fitting ferrules by steel bands *F*. The method of assembly is to apply one end fitting *C* to the hose, slip on the asbestos cover and push it back far enough to permit the other end fittings to be applied, then draw it over both fittings and crimp the bands *F* in place. The asbestos cover acts as a flame shield for the enclosed hose and fittings, and it, together with the entrapped air, provides a heat insulating blanket. The oil-proof coating on the cover and its tight seals at the ends by bands prevents any absorption of combustible fluid by the cover or any leaking thereof into the air space from the outside even if the assembly should accidentally be submerged.—*June* 18, 1958.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.

DIESEL ENGINES FOR RAIL TRACTION

No. 2953 : 1958. Price 6s. The new standard on diesel engines for rail traction is expected also to be of benefit in helping British exports of diesel engines and of complete rail traction units such as diesel-powered locomotives. It contains details of the tests which an engine must pass if it is to comply with the standard. Thirty-eight items of information to be supplied by a manufacturer at the time of tendering are listed. Guidance is also given on the ancillary equipment (such as pumps and pipework) to be included with the engine itself, and on traction rating and conditions.

The provisions of the standard, notably the test requirements and procedures, have been taken into account practice overseas and particularly "Rules for Diesel Engines for Traction," issusd by the International Union of Railways. Engines made to the new standard, therefore, should meet the regulations of many of the most important markets abroad.

VERIFICATION OF TESTING MACHINES

No. 1610, Part I : 1958. Price 6s. This revised edition of this standard gives a more realistic standard for loads above 50 tons force and the accuracy in this range is now in agreement with the provisions of American and Continental standards. Below this range, greater accuracy is required and to cover this need a section has been added dealing with the requirements for the calibration and the use of elastic proving devices. This new section covers only those devices in which the load is determined by measurement of the elastic deflection of a loaded member. Measurement by this method may be made by mechanical, electrical, optical or other means of sufficient precision and stability. Included in this section are tables for the grading of elastic proving devices and also tables for deflection and correction values for variations in temperatures for both the Centigrade and Fahrenheit temperature scale. Other sections in the revision deal with methods of load verification and verification of machines for tension and compression testing. A table has been added for the grading of tension, tension and compression and compression machines ; this table gives the maximum permissible errors for Grade A, B and C machine scales.

Launches and Trial Trips

MERINGA, bulk sugar carrier ; built by Hall Russell and Co., Ltd., for the Adelaide Steamship Company, Ltd.; length overall 415ft, four cargo holds, MacGregor steel hatch covers, deadweight 7100 tons ; three 125kW diesel-driven generators ; Ailsa-Doxford oil engine burning heavy fuel, four cylinders, 560mm diameter by 2160mm combined stroke, 3000 b.h.p. Launch, June 2.

PENNYWORTH, ore carrier ; built by Smith's Dock Company, Ltd., for R. S. Dalgliesh, Ltd.; length between perpendiculars 480ft, breadth moulded 68ft 9in, depth moulded 36ft 3in, deadweight 15,500 tons on 28ft 11in draught, service speed 11½ knots ; four main holds, wing tanks at sides, MacGregor hatch covers ; three 20kW diesel-driven generators ; Hawthorn-Doxford opposed-piston diaphragm ; two-stroke oil engine, four cylinders, 670mm diameter by 2320mm combined stroke, 4450 b.h.p. at 115 r.p.m. Launch, June 2.

JEDMOOR, open shelter deck cargo ship ; built by Hawthorn Leslie (Shipbuilders), Ltd., for the Moor Line, Ltd.; length between perpendiculars 435ft, breadth moulded 60ft 6in, depth moulded to freeboard deck 29ft 9in, deadweight 9825 tons, draught 26ft 4in, service speed 14½ knots ; five cargo holds, one 30-ton and ten 5/10-ton derricks, electric winches ; three 200kW diesel-driven generators ; Hawthorn-Doxford oil engine, five cylinders, 670mm diameter by 2320mm combined stroke, 5500 b.h.p. at 115 r.p.m. Launch, June 2.

SUNHEIM, bulk carrier ; built by Joseph L. Thompson and Sons, Ltd., for A/S Tank, Oslo ; length between perpendiculars 458ft, breadth moulded 62ft, depth moulded 42ft, deadweight 15,050 tons on 30ft 9in draught, trial speed 15 knots ; five continuous holds with hopper sides at bilge and sloping ballast tanks below upper deck ; five hatches, MacGregor single pull covers, electric winches ; N.E.M.-Doxford oil engine, four cylinders, 700mm diameter by 2320mm combined stroke, 4900 s.h.p. at 116 r.p.m. Launch, June 3.

AUTHOR, closed shelter deck cargo ship ; built by William Doxford and Sons (Shipbuilders), Ltd., for the Ruthin Steamship Company, Ltd.; length overall 490ft, breadth 62ft, depth 39ft 6in, deadweight 9400 tons, service speed 14½ knots ; five hatchways, derrick complement includes two to lift 70 tons, electric winches ; Doxford opposed-piston oil engine, six cylinders, 670mm diameter by 2320mm combined stroke. Launch, June 4.

RAGUSA, oil tanker ; built by the Netherlands Dock and Shipbuilding Company, Ltd., for Afran Transport company, Liberia ; length overall 660ft breadth 86ft, depth 45ft, draught loaded 34ft 1in, deadweight 30,900 tons, displacement 40,400 tons ; service speed 15½ knots ; two 550kW turbo-alternators ; one set of three-stage, double-reduction geared Parsons turbines, 9900 s.h.p., steam supplied at 500 lb per square inch gauge and 800 deg. Fah. by two N.D.S.M.-Babcock and Wilcox boilers. Launch, June 7.

CALTEX NEWCASTLE, oil tanker ; built by Hawthorn Leslie (Shipbuilders), Ltd., for Overseas Tankship, Ltd.; length overall 559ft, breadth moulded 71ft, depth moulded to upper deck 39ft 9in, deadweight 18,250 tons ; twenty-seven oil cargo tanks, one main pump room, three horizontal turbine-driven cargo pumps, and three vertical duplex stripping pumps ; two 450kW turbo-alternators, one 150kW diesel-driven generator ; one set of double-reduction geared turbines, 8400 s.h.p., take steam at 600 lb per square inch and 950 deg. Fah. from two Foster-Wheeler "D" boilers. Trial, June 4 and 5.

KATEA, cargo ship ; built by Alexander Stephen and Sons, Ltd., for the Union Steam Ship Company of New Zealand, Ltd.; length 325ft, beam 51ft, depth 26ft, deadweight 5400 tons, three hatches, MacGregor single pull covers, twelve derricks ; Stephen-Sulzer single-acting diesel engine, six cylinders, 600mm diameter by 1040mm stroke, 2410 b.h.p. at 128 r.p.m. Trial, June.

Catalogues and Brochures

ALLEN WEST AND CO., Ltd., Brighton.—Leaflet illustrating standard air-break starters in flush mounting enclosures.

HUNTING AEROSURVEYS, Ltd., 4, Albemarle Street, London, W.1.—Illustrated leaflet describing photographic mosaics.

DANKS OF NETHERTON, Ltd., Netherton, Dudley.—Illustrated leaflet describing the "Supapak" oil fired package boiler.

LONDON FAN AND MOTOR COMPANY, Ltd., 27, Brecknock Road, London, N.7.—Leaflet giving details of "Breezamatic" dual fan units.

WHITEHOUSE INDUSTRIES, Ltd., Ferrybridge, Knottingley, Yorkshire.—Catalogue giving technical details of "Philidas" self-locking nuts.

SELF-CHANGING GEARS, Ltd., Lythalls Lane, Coventry.—Publication dealing with the history of the company and the Wilson gearbox.

STURTEVANT ENGINEERING COMPANY, Ltd., Southern House, Cannon Street, London, E.C.4.—Publication No. 5013 entitled "Portable Swarf Collecting Unit."

E.M.I. ELECTRONICS, Ltd., Hayes, Middlesex.—Folder describing a hand and clothing monitor for the simultaneous detection of both alpha and beta contamination.

BROOKS AND WALKER, Ltd., 47, Great Eastern Street, London, E.C.2.—Illustrated booklet and price list for the "Diprofil" multi-purpose hand filing machine and supplementary equipment.

MARCONI'S WIRELESS TELEGRAPH COMPANY, Ltd., Marconi House, Chelmsford, Essex.—Illustrated booklet giving details of the HSR 21 SSB radiotelephone for communication over medium distances.

GENERAL ELECTRIC COMPANY, Structures Laboratory, Missile and Ordnance Systems Department, 3198, Chestnut Street, Philadelphia 4, Pa.—Booklet describing the work of the structures laboratory.

FERRANTI, Ltd., Hollinwood, Lancs.—Brochure IN.1 describing and illustrating rectangular panel instruments. The range, which covers moving coil d.c., a.c. rectifier, thermal, moving iron, electrostatic and hermetically sealed instruments, can be supplied with mirror scale if required.

ALBRIGHT AND WILSON, Ltd., 1, Knightsbridge Green, London, S.W.1.—Illustrated booklet entitled "Facts about Albright and Wilson," describing briefly the structure of the group of companies and the activities of some of the larger manufacturing companies within the group.

FIRE PROTECTION ASSOCIATION, 15, Queen Street, London, E.C.4.—Fire Protection Bulletin "Nothing to Burn," showing that nearly every factory contains combustible material of some kind and some possible causes of fire. The Bulletin includes check lists to assist in discovering hazards that may have been neglected.

ASSOCIATED ELECTRICAL INDUSTRIES, Ltd., 20, Neasden Lane, Willesden, London, N.W.10.—Booklet describing the A.E.I., a.c. network analyser, first placed in commission in 1947 for the study and solution of problems associated with the supply of electrical power. Calculations can often be reduced on many non-electrical problems when the terms can be represented by electrical equivalents, and it is consequently the intention of A.E.I. that the network analyser should be available to assist in all the relevant fields of engineering and scientific endeavour. Any supply authority, manufacturing company, industrial organisation or scientific body wishing to make use of the services offered is asked to communicate with the engineer in charge.

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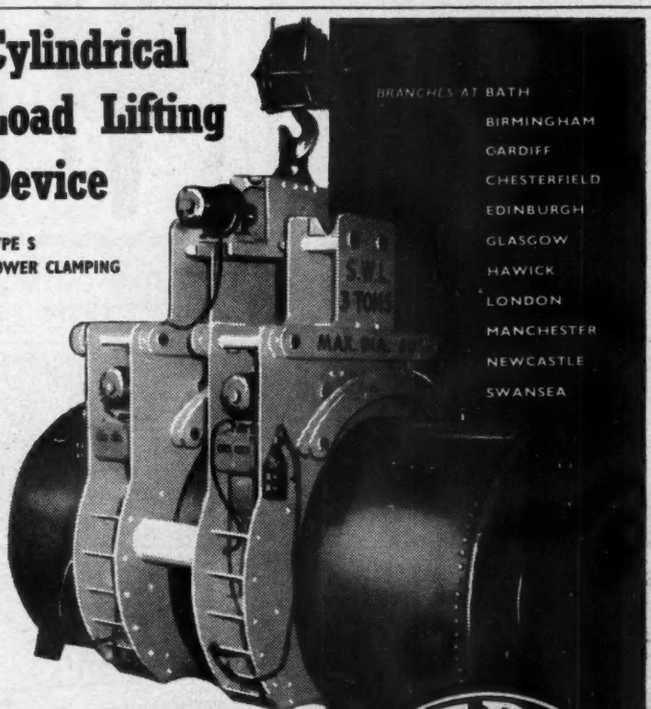

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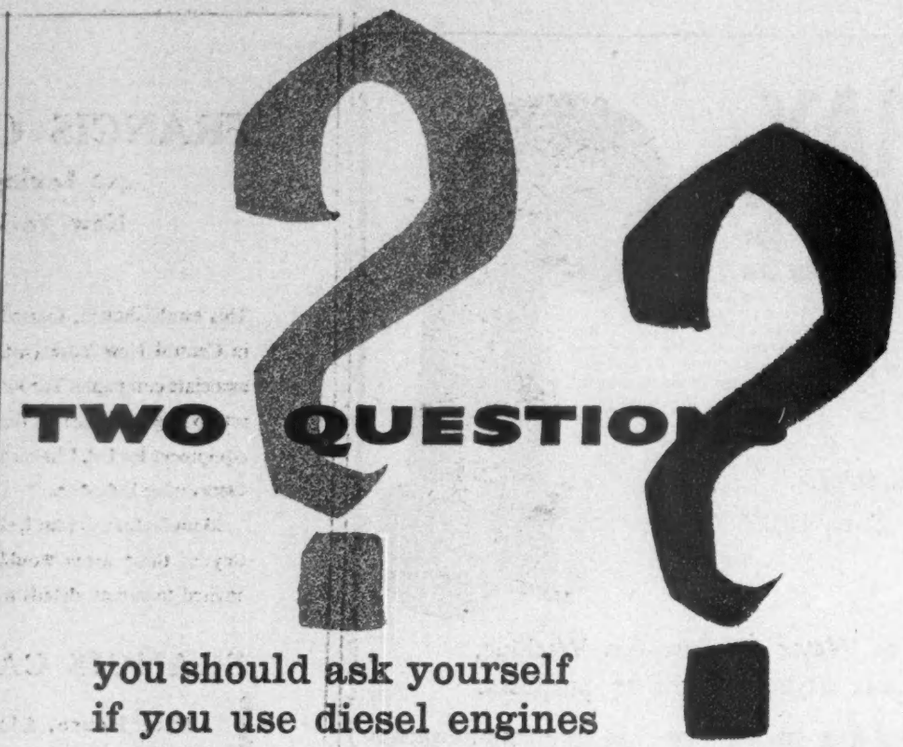

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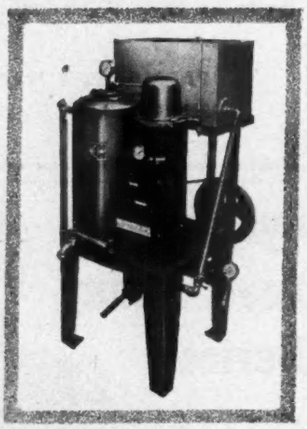

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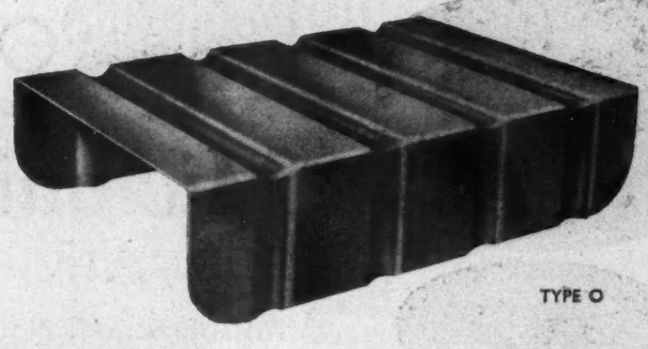

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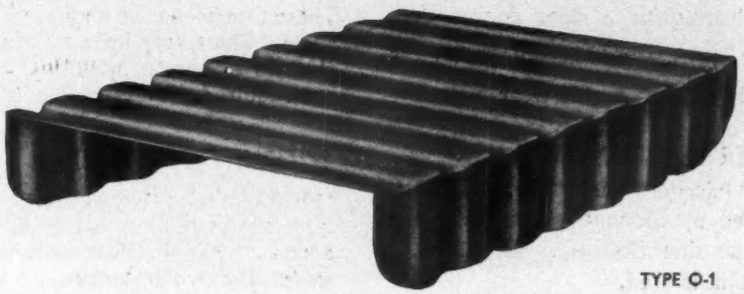

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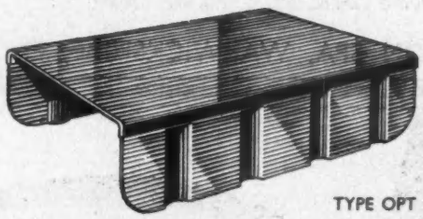

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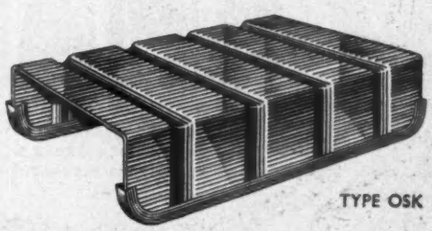

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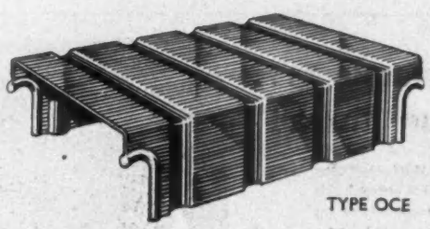

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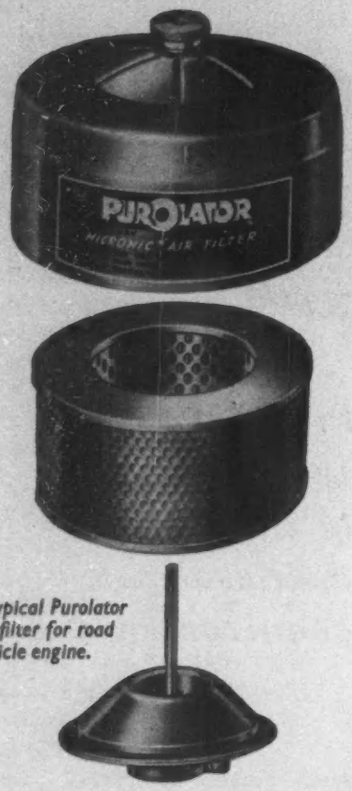

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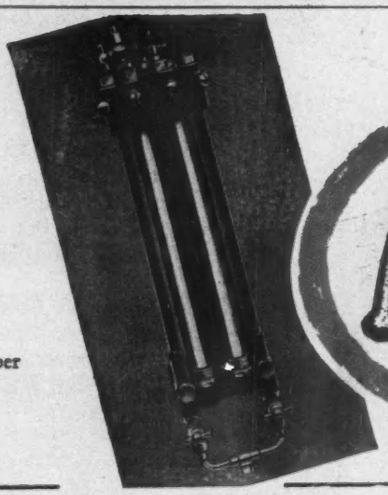

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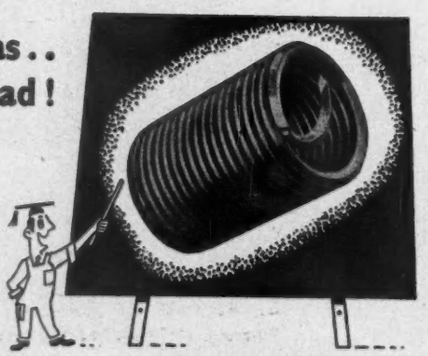

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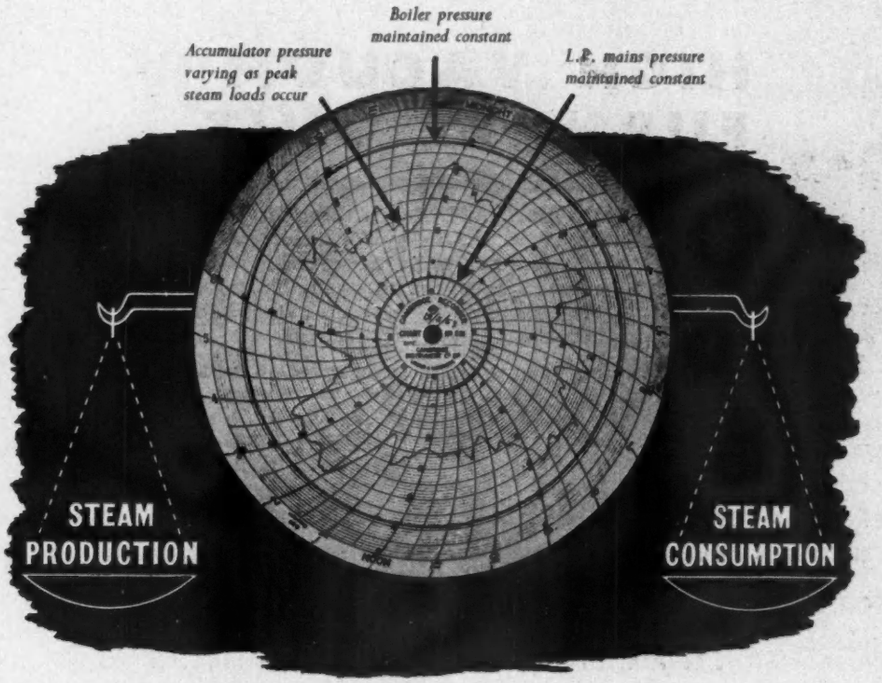
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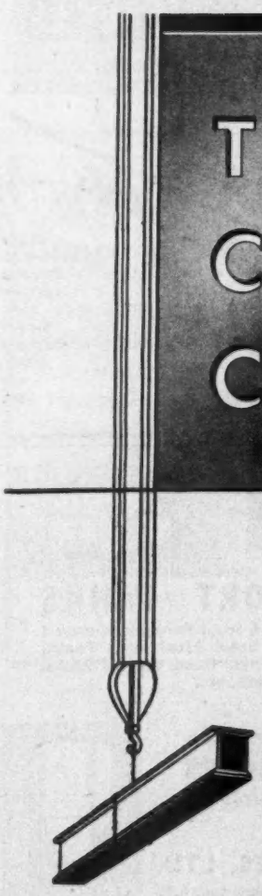

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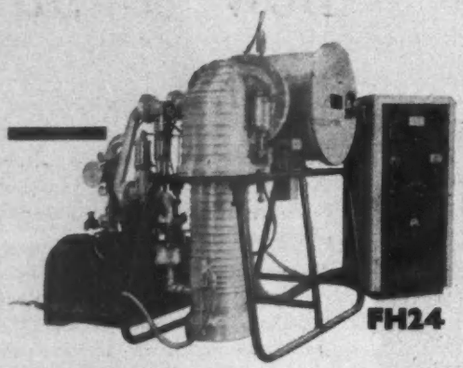

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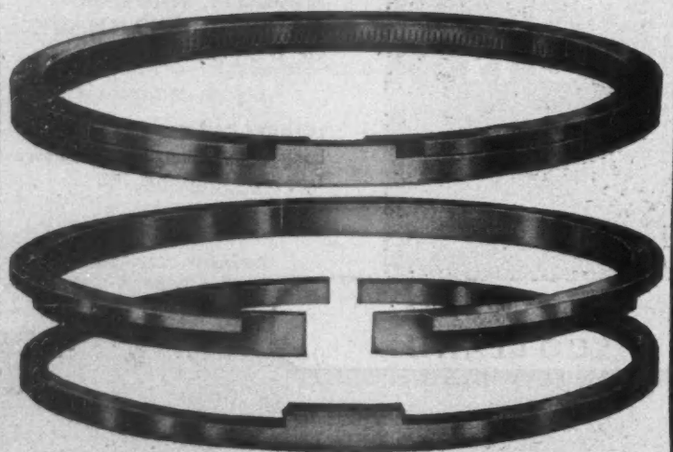

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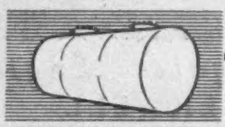

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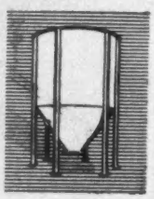

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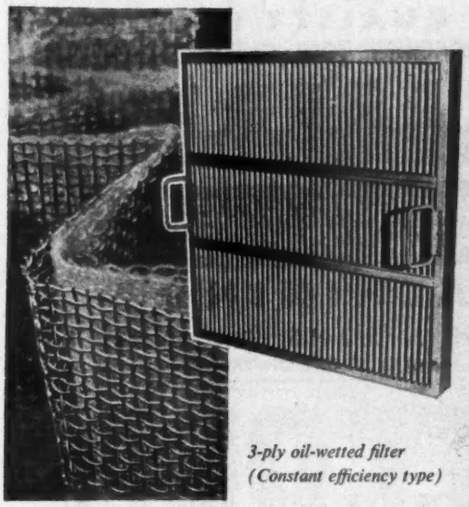
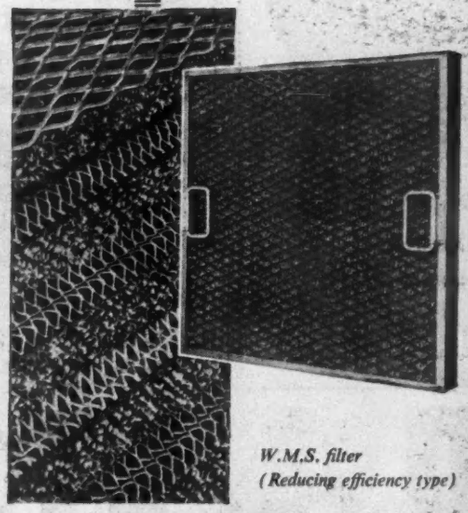


3-ply oil-wetted filter (Constant efficiency type)



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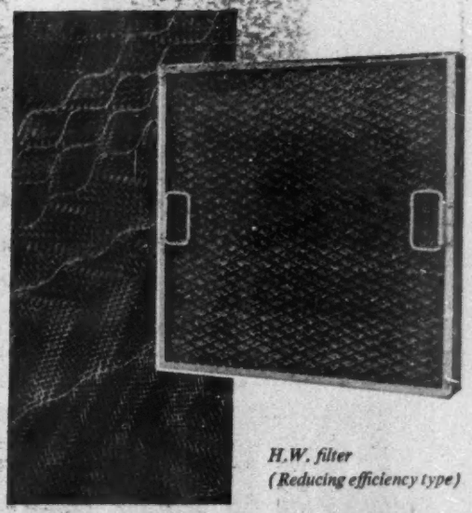

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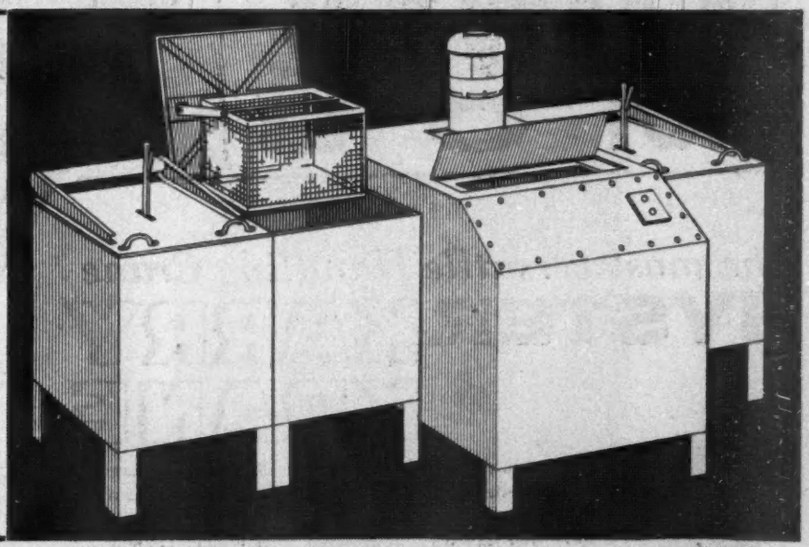

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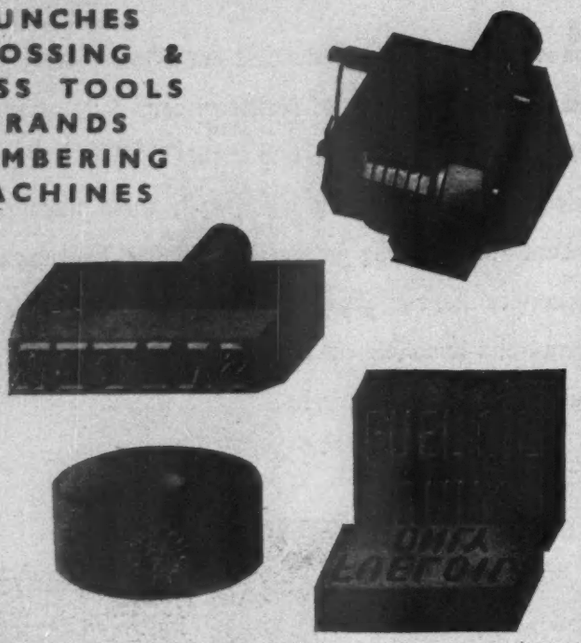

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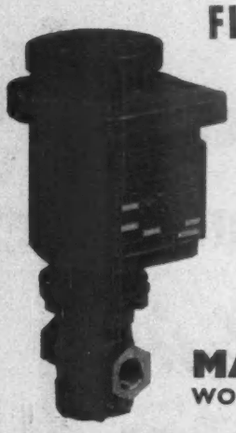

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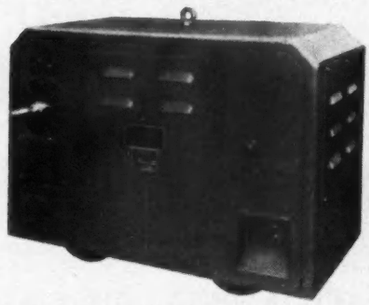

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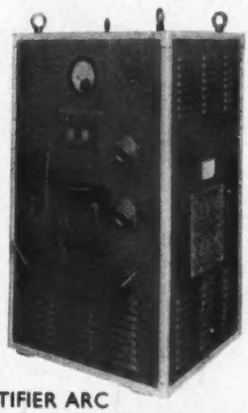

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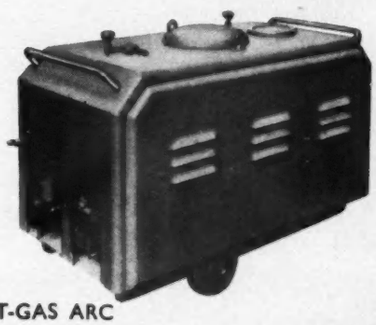

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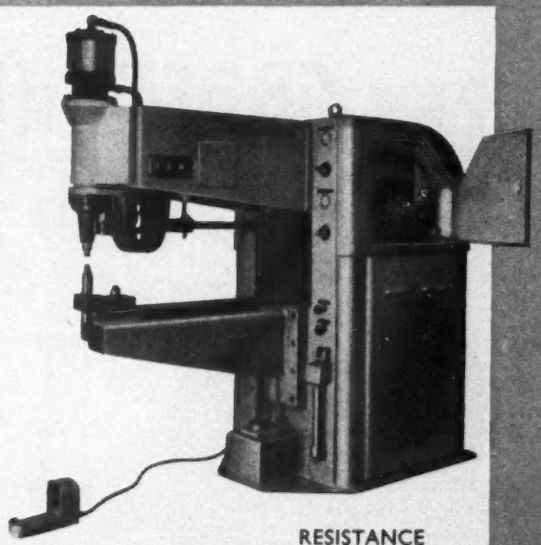

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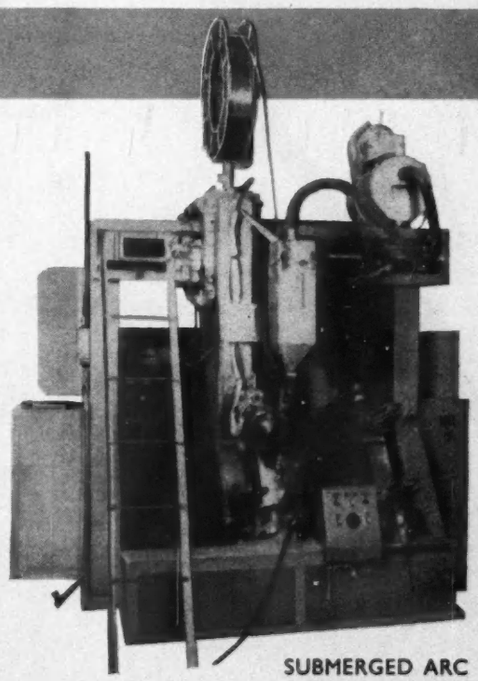

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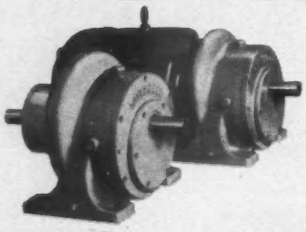

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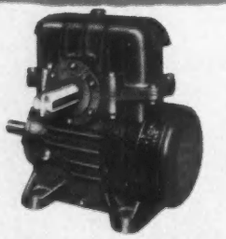

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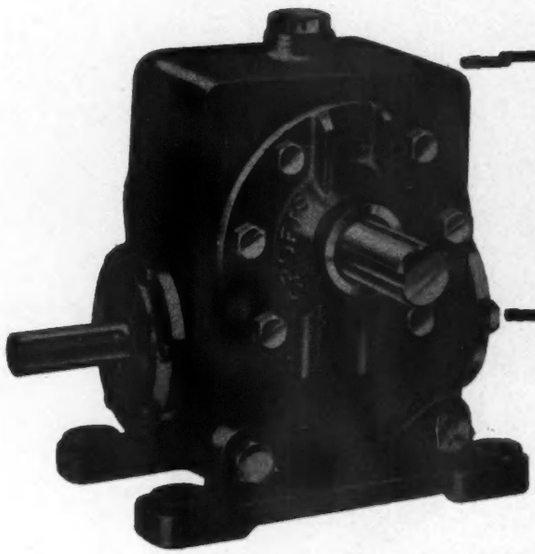

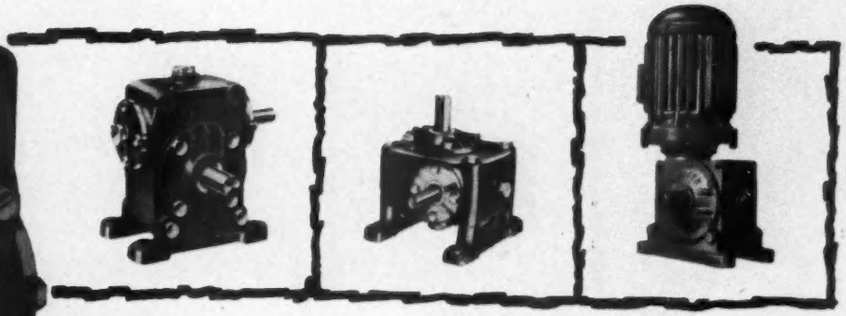

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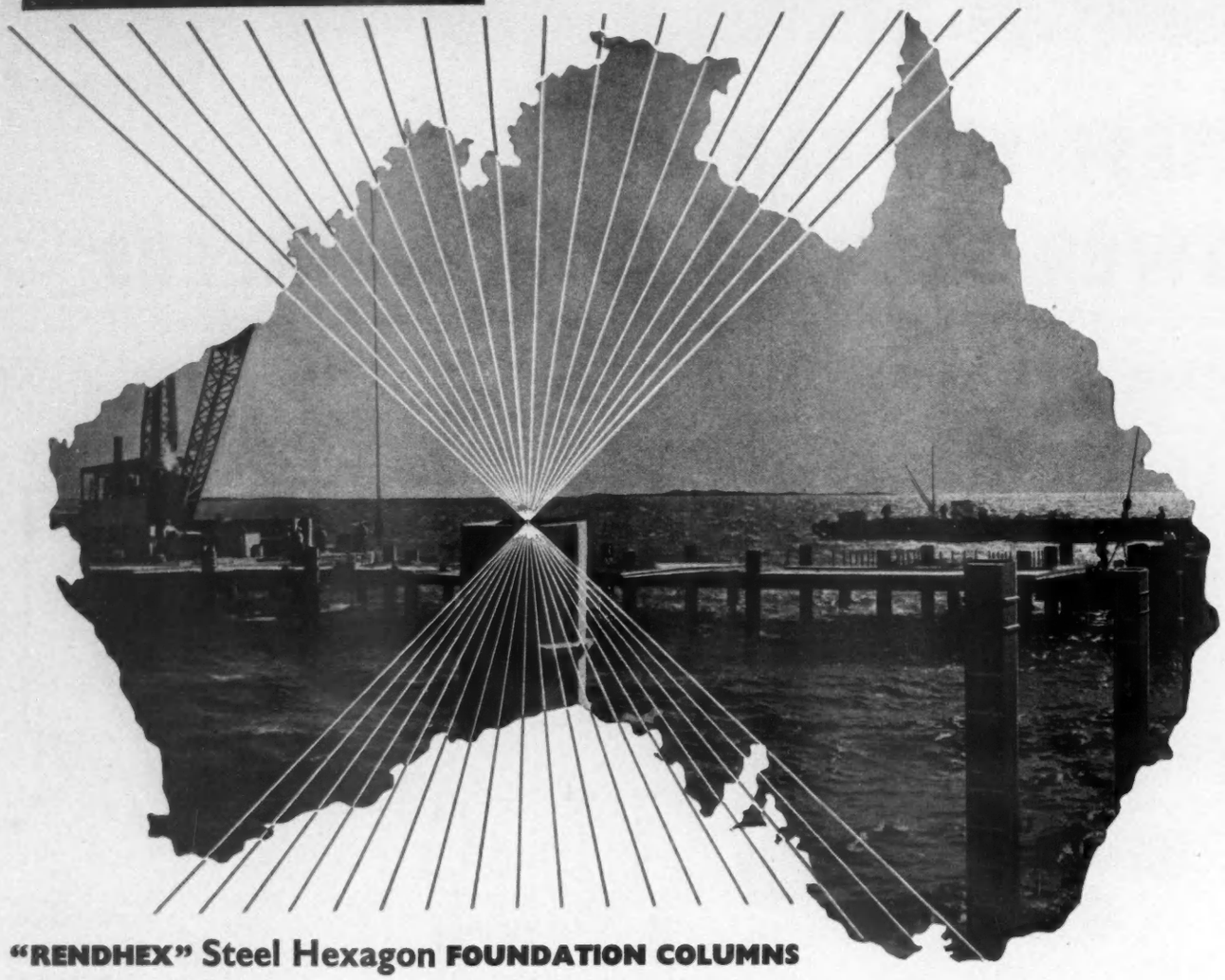

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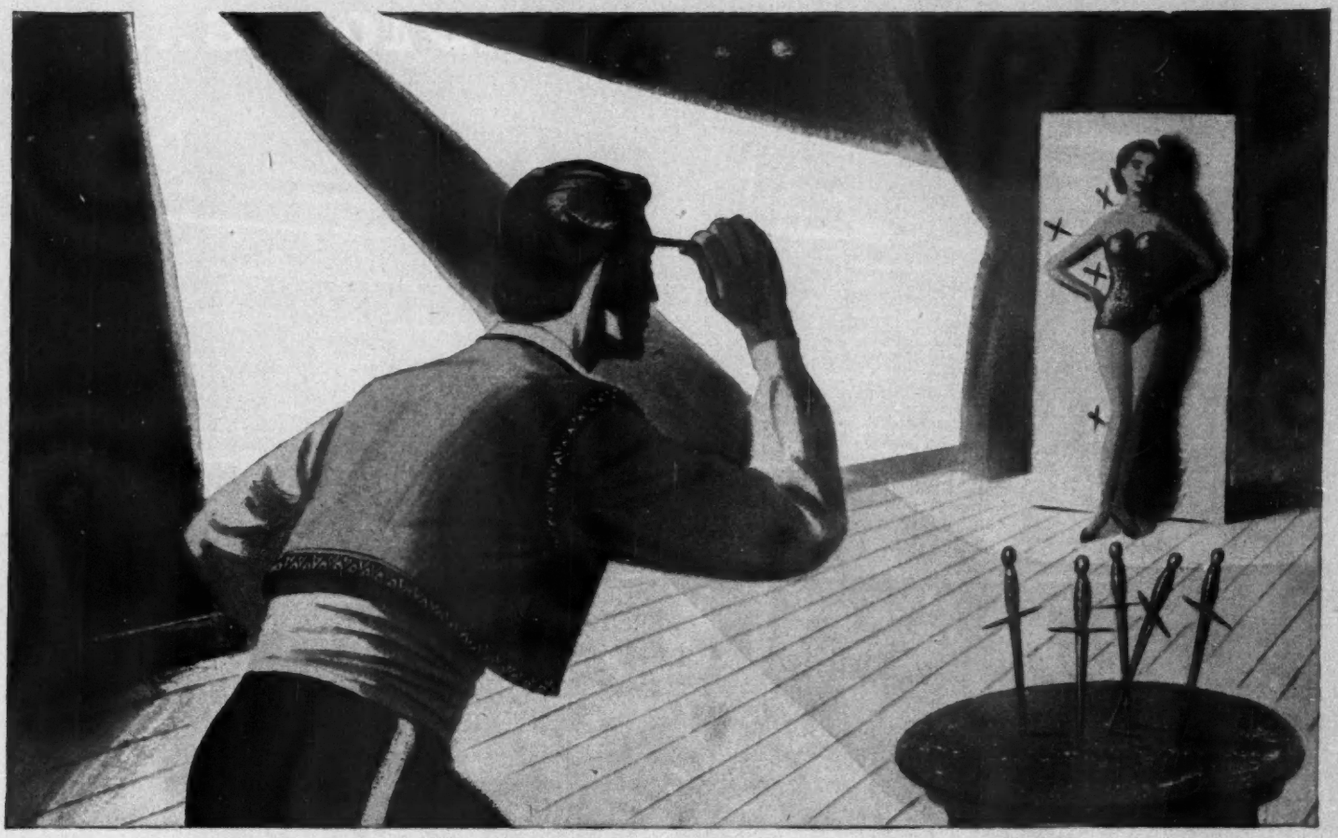

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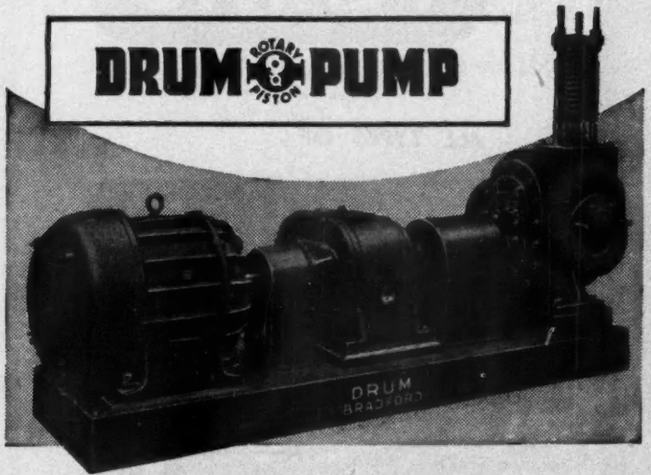

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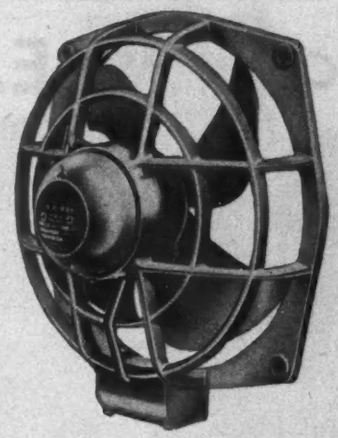

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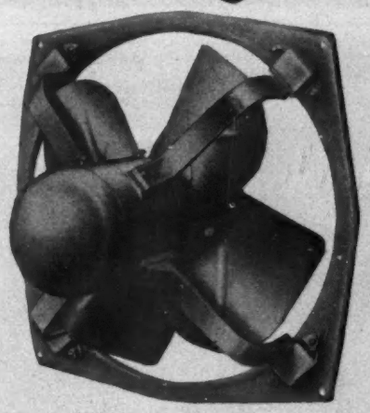

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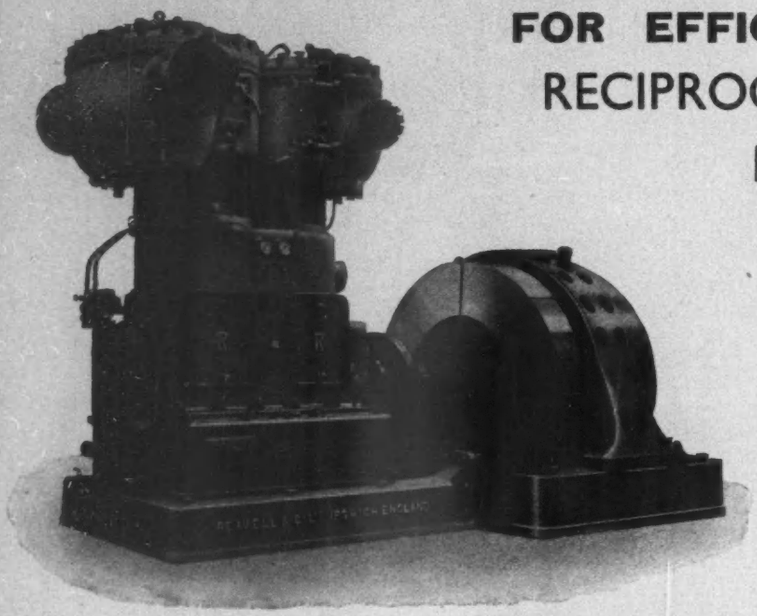

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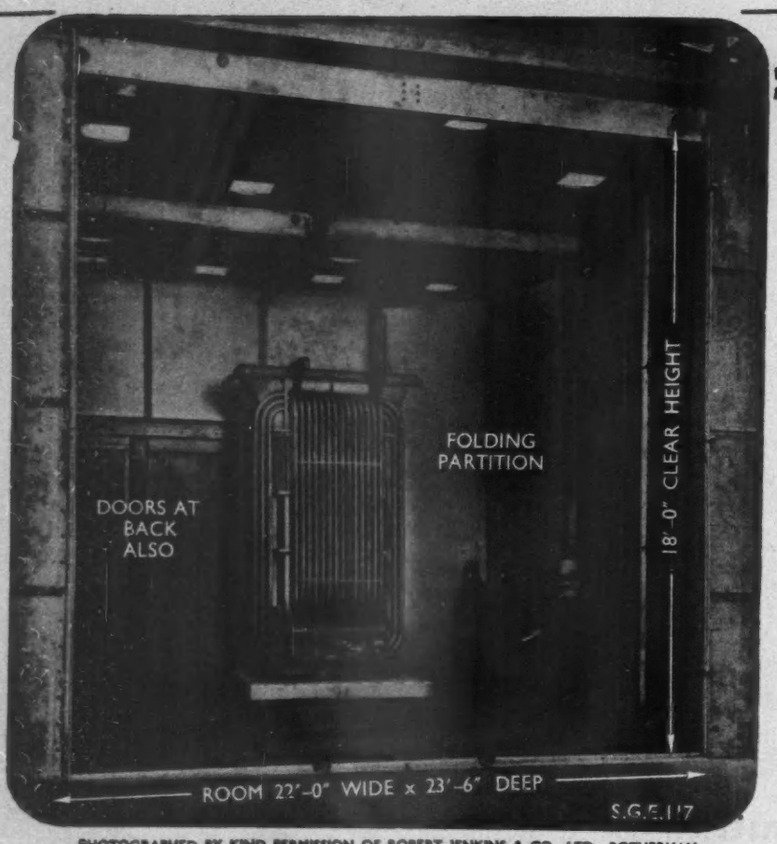

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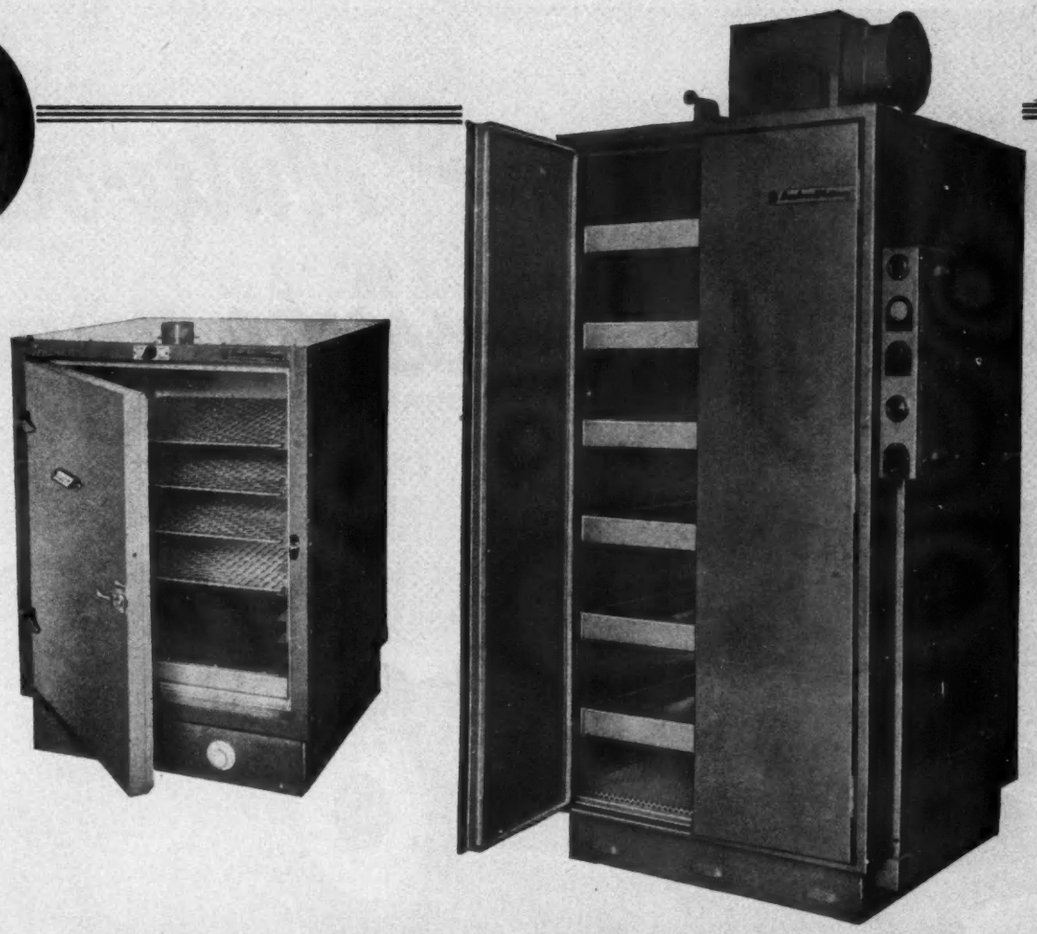

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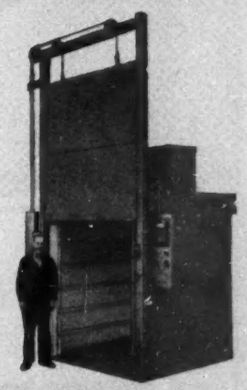

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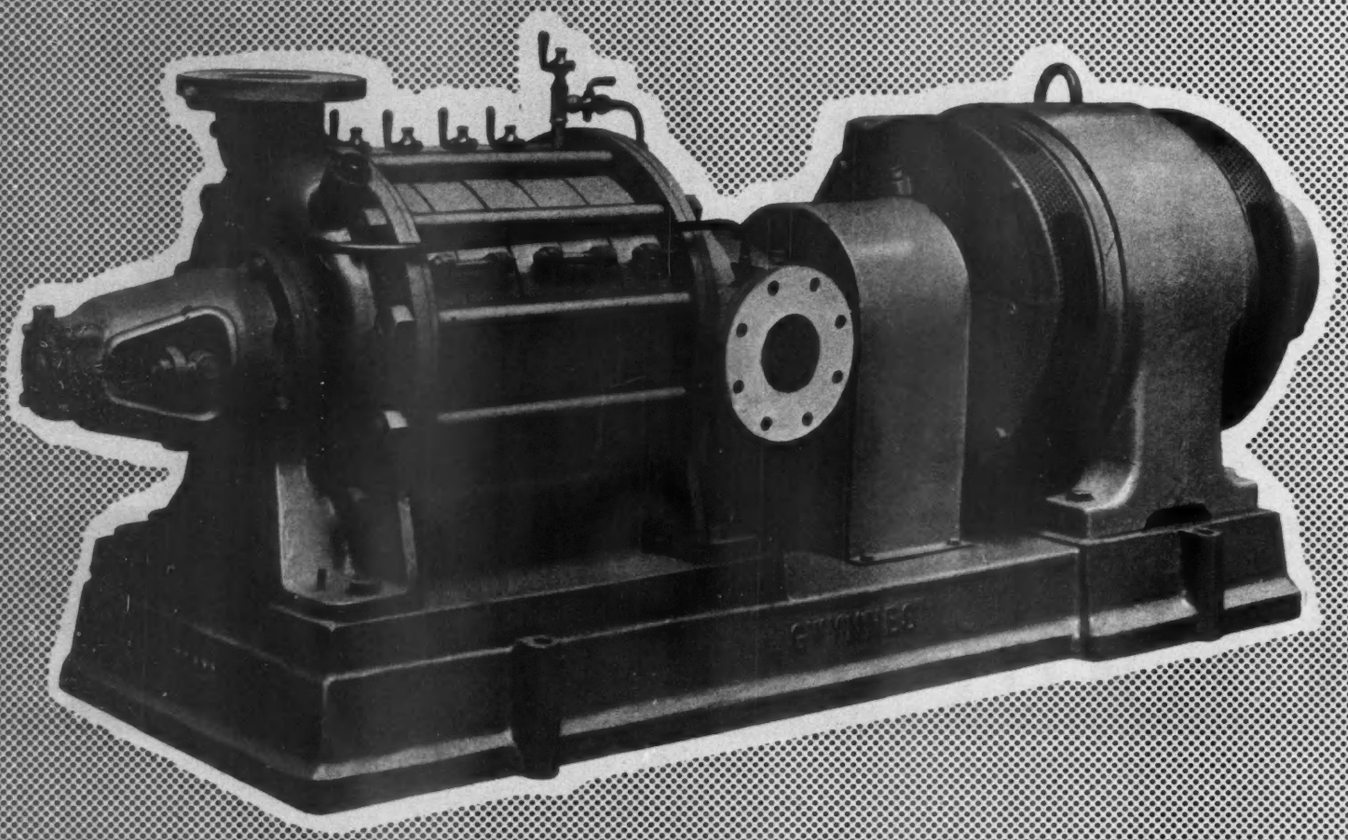

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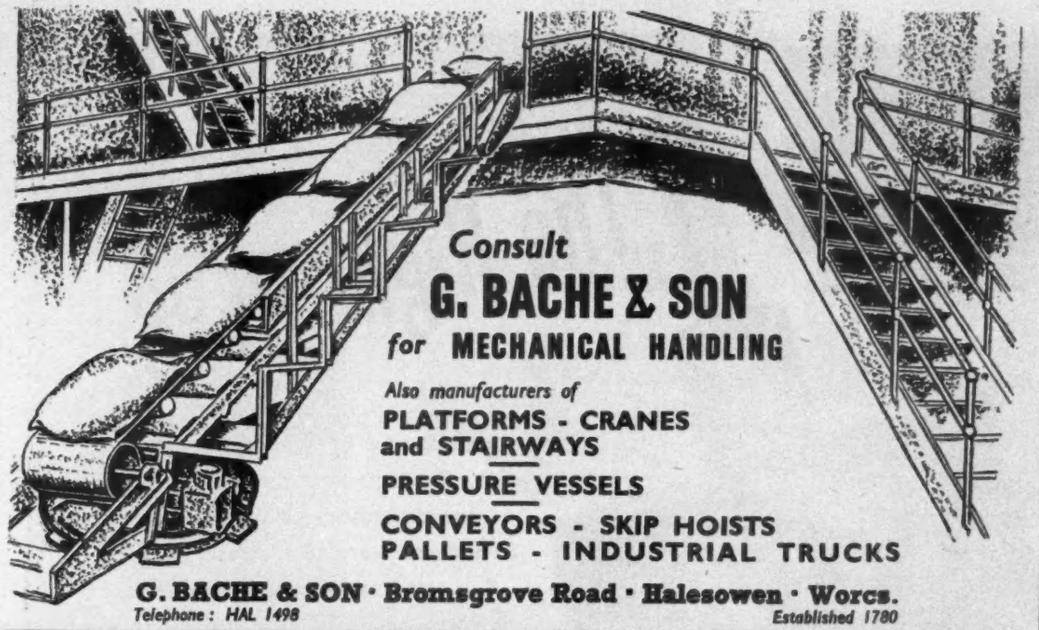

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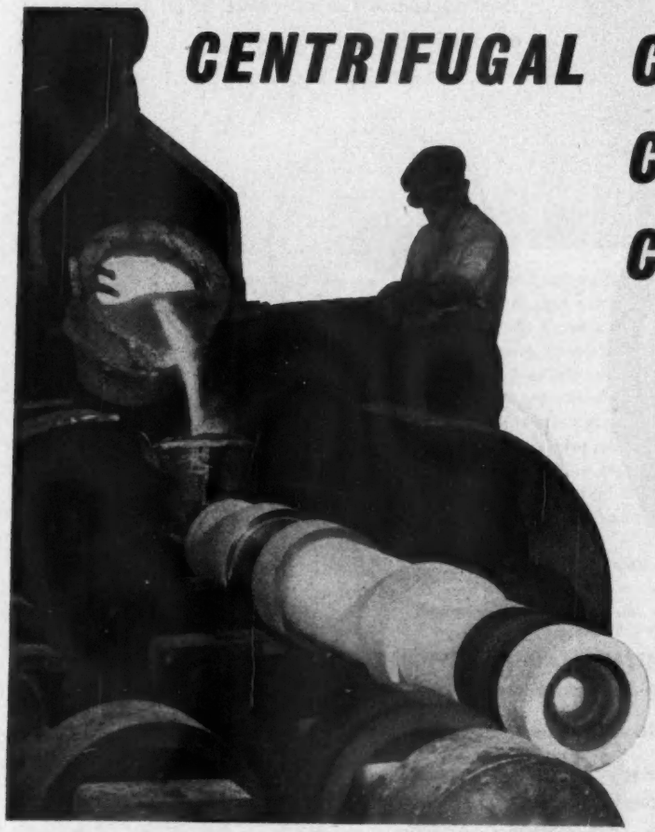

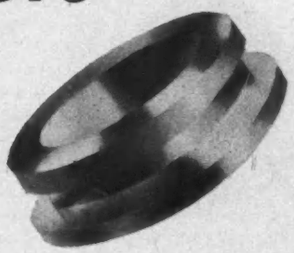

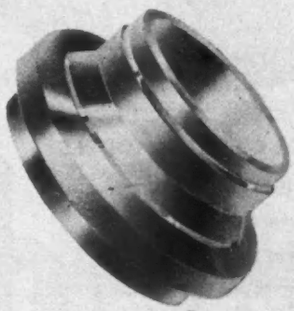

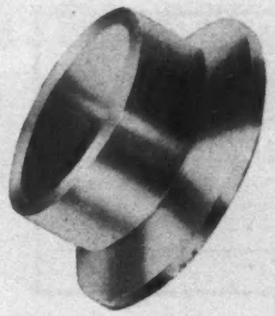

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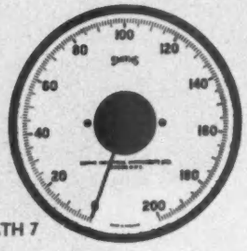
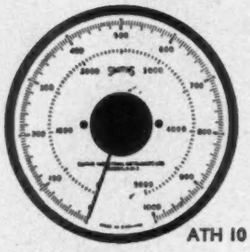


ATH 7



ATH 10

SMITHS HAND TACHOMETERS
can be used for checking:—

Rotational speeds of shafts, spindles, gears, rotors and rolls.

Linear speeds in ft/min or metres/min of metal strips, textiles, paper, wire, plastic, film and conveyed material.

Surface speeds in ft/min or metres/min of cutting or grinding operations of machine tools, processing rolls, unwind rolls or wind up rolls for extrusion and strip production.

Readings can be taken in bad lighting conditions or where the dial is visually obscured.

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Model A.T.H.10 dial illustrated (0-5,000 r.p.m.)

ALL FOR L.H. OR R.H. DIRECTION OF ROTATION.

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Please send full details of your HAND TACHOMETERS

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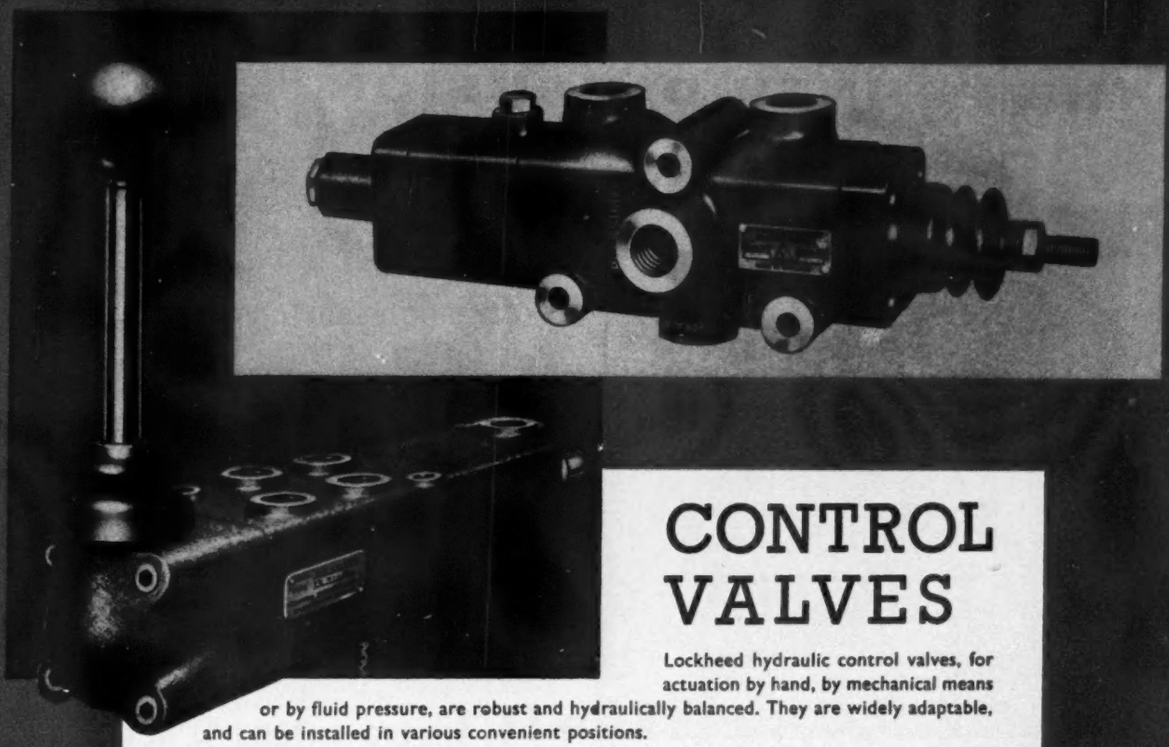

CONTROL VALVES

Lockheed hydraulic control valves, for actuation by hand, by mechanical means or by fluid pressure, are robust and hydraulically balanced. They are widely adaptable, and can be installed in various convenient positions.

The illustration on the left shows a Lockheed ¼" B.S.P. valve: this is subject to many variations in installation and porting, there being 11 types with 14 variations in valve spools, operable with spring self-centering or self-reversing (either way) or with detent location. The end covers can be turned to occupy any one of four angular positions. All working parts are protected by suitable boots and air filters as necessary. Suitable for fluid flows up to 6 g.p.m. and 3000 p.s.i.

The right-hand illustration shows one of the Lockheed ½" B.S.P. control valves, of which there are 18 types, and 18 variations in body form. The spools are a floating fit on their operating spindles, and are thus self-aligning; they are also hydraulically balanced. Spring return and detent location are available as in the smaller valve. Suitable for fluid flows up to 20 g.p.m. and 1000 p.s.i.

The 1¼" B.S.P. has similar features with 8 types of body and 9 variations in spool. Capacity: up to 50 g.p.m. and 3000 p.s.i.

For further details of these and other Lockheed Industrial units, please write for pamphlets and kindly mention this journal.

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COMPLETE INSTALLATIONS BRITISH MADE OR INDIVIDUAL UNITS

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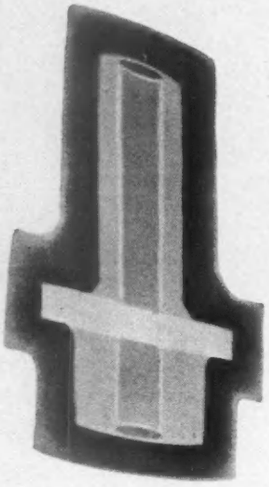
THE FOURTH DIMENSION



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Member Companies of the Birfield Group were some of the earliest in this country to install regular X-ray examination of their products as the 4th dimensional check on the quality of their productions. Up-to-the-minute methods are part of the secret of Birfield Group success. Every Member Company of the Group is backed by the resources—manufacturing and technical—of every other company in the Group.

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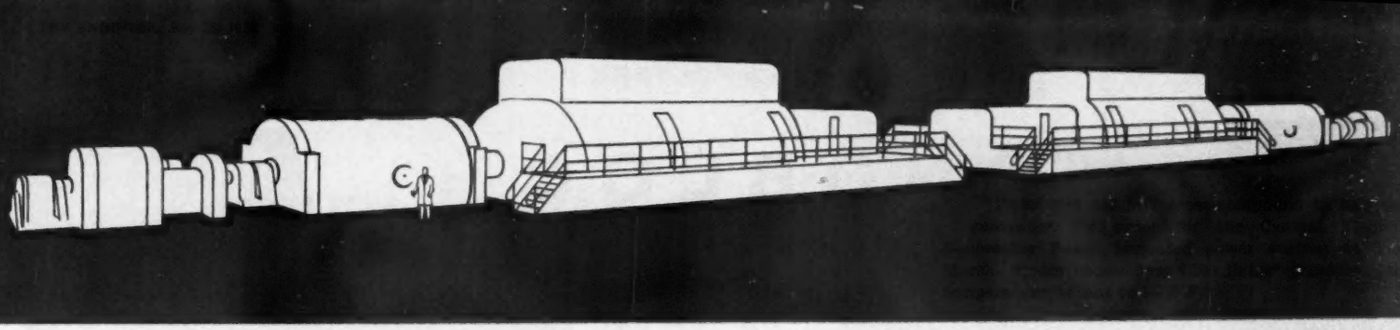
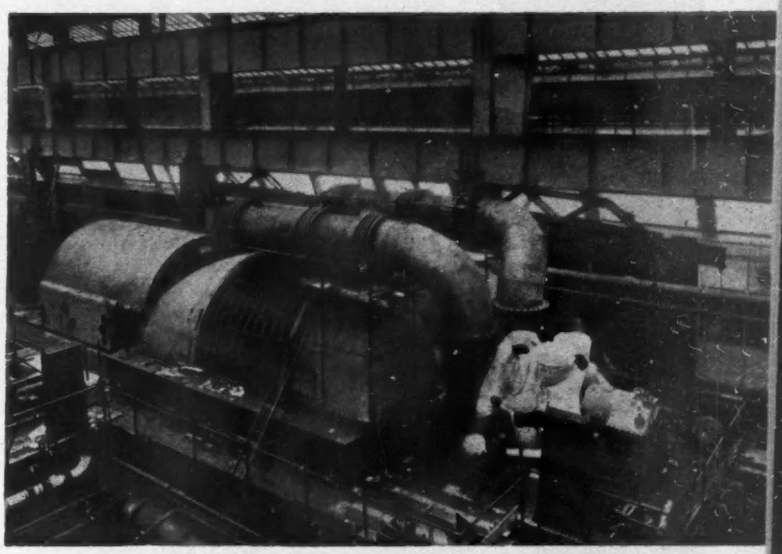
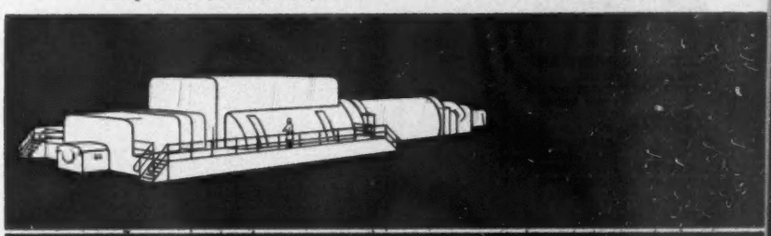


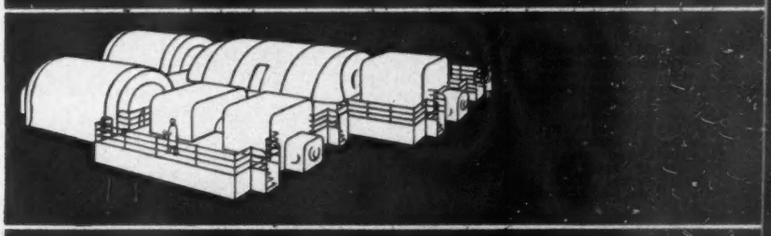
Increasing power output

A significant development in the design of steam turbo-generators for power stations is the increase in the power output of individual machines. This is evident in the range of large turbo-generators now under construction at Heaton Works.



PARSONS 200 MW cross-compound turbo-generator (View of low pressure line only). Four of these machines are under construction for the Hydro Electric Power Commission of Ontario, Richard L. Hearn Generating Station. Steam conditions: 1,800 lb/in² pressure, 1,000°F temperature, reheat to 1,000°F.





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TURBO-GENERATORS

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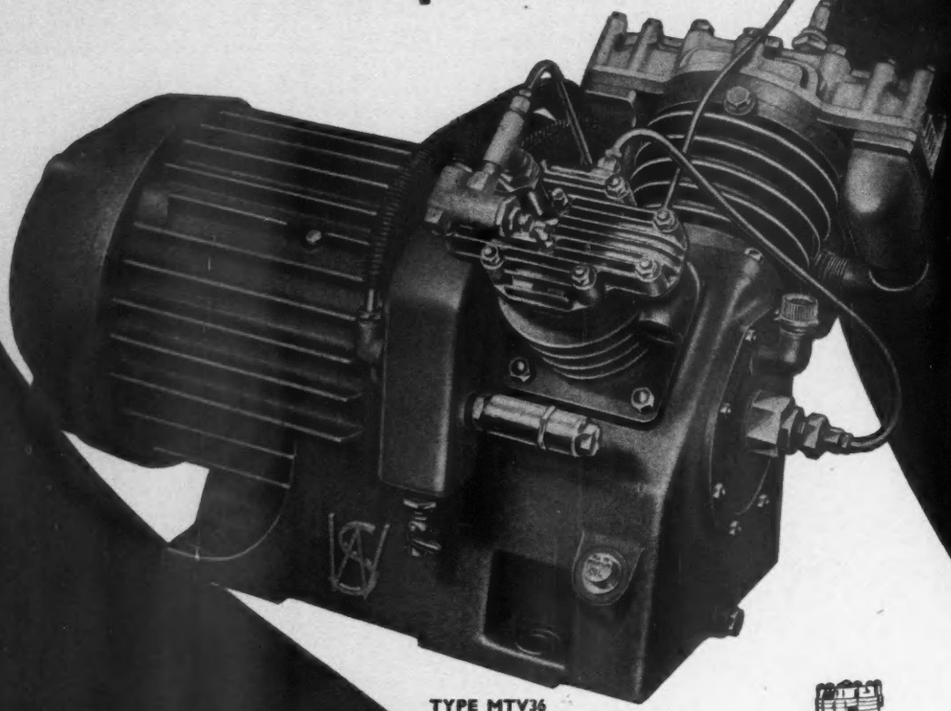
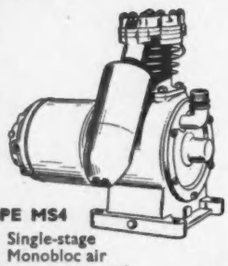
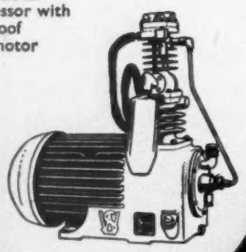
MONOBLOC
air compressors



TYPE MTV36
Two-stage Monobloc air compressor with intercooler and 10 h.p. totally enclosed, fan-cooled motor.

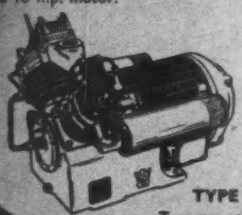


TYPE MS4
Single-stage Monobloc air compressor with drip-proof 1 h.p. motor

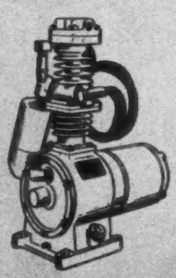


TYPE MTT8
Two-stage, tandem-type Monobloc air compressor with totally enclosed, fan-cooled 3 h.p. motor.

TYPE MSV55
...gle-stage Monobloc ...r compressor with ...tally enclosed, fan-...oled 10 h.p. motor.



TYPE MTT3
Two-stage tandem-type Monobloc air compressor, with drip-proof, 1 h.p. motor.



TYPE MS19
Single-stage Mono...bloc air compress... with totally enclo... fan-cooled 3 h.p. motor.

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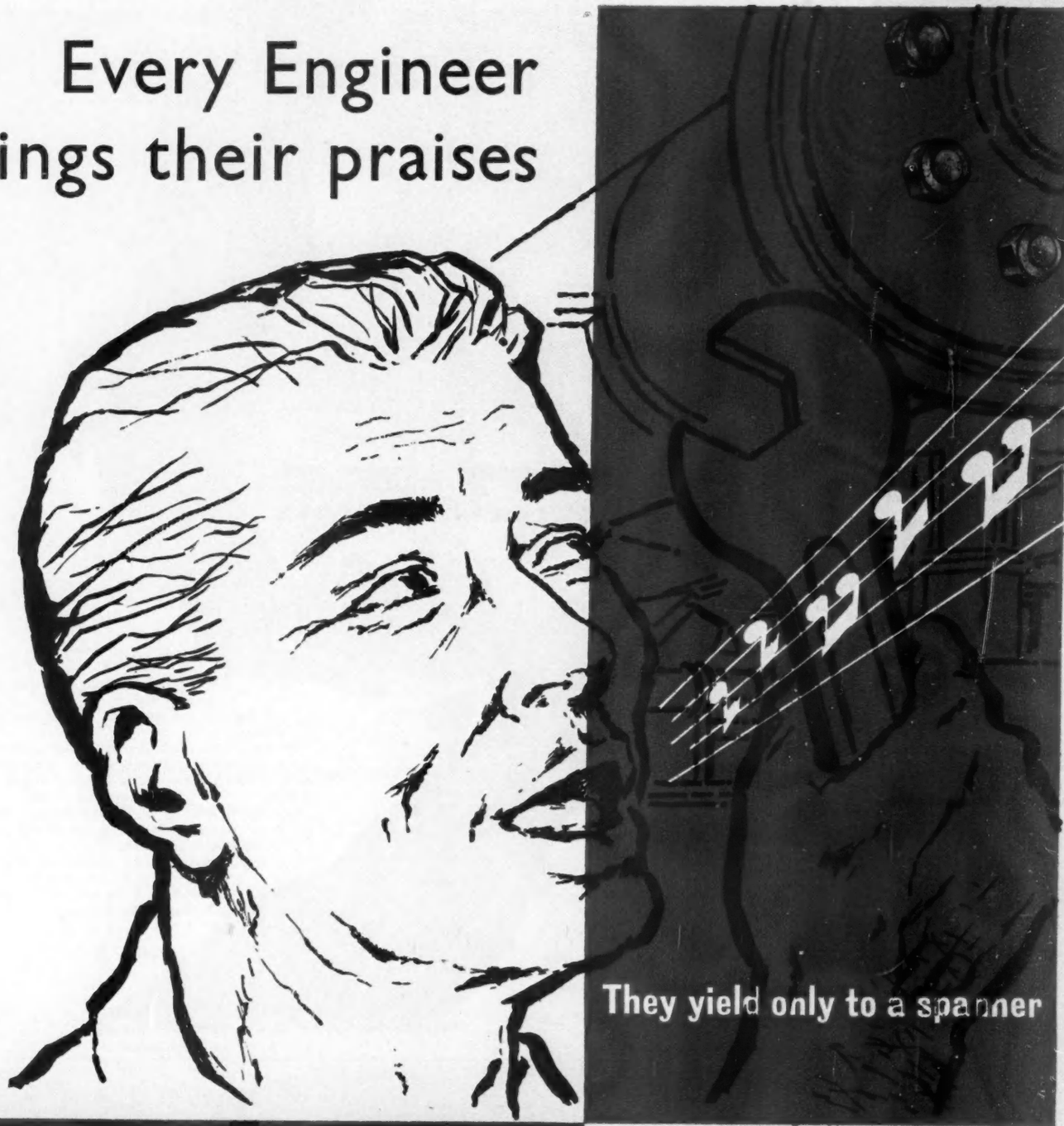

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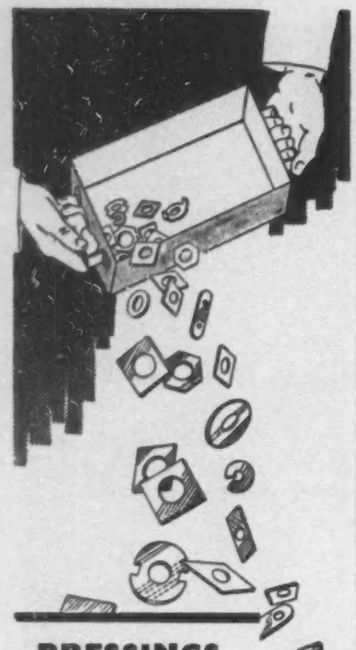

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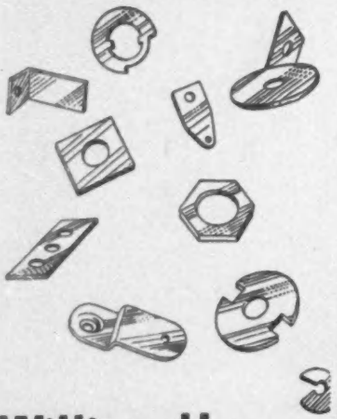

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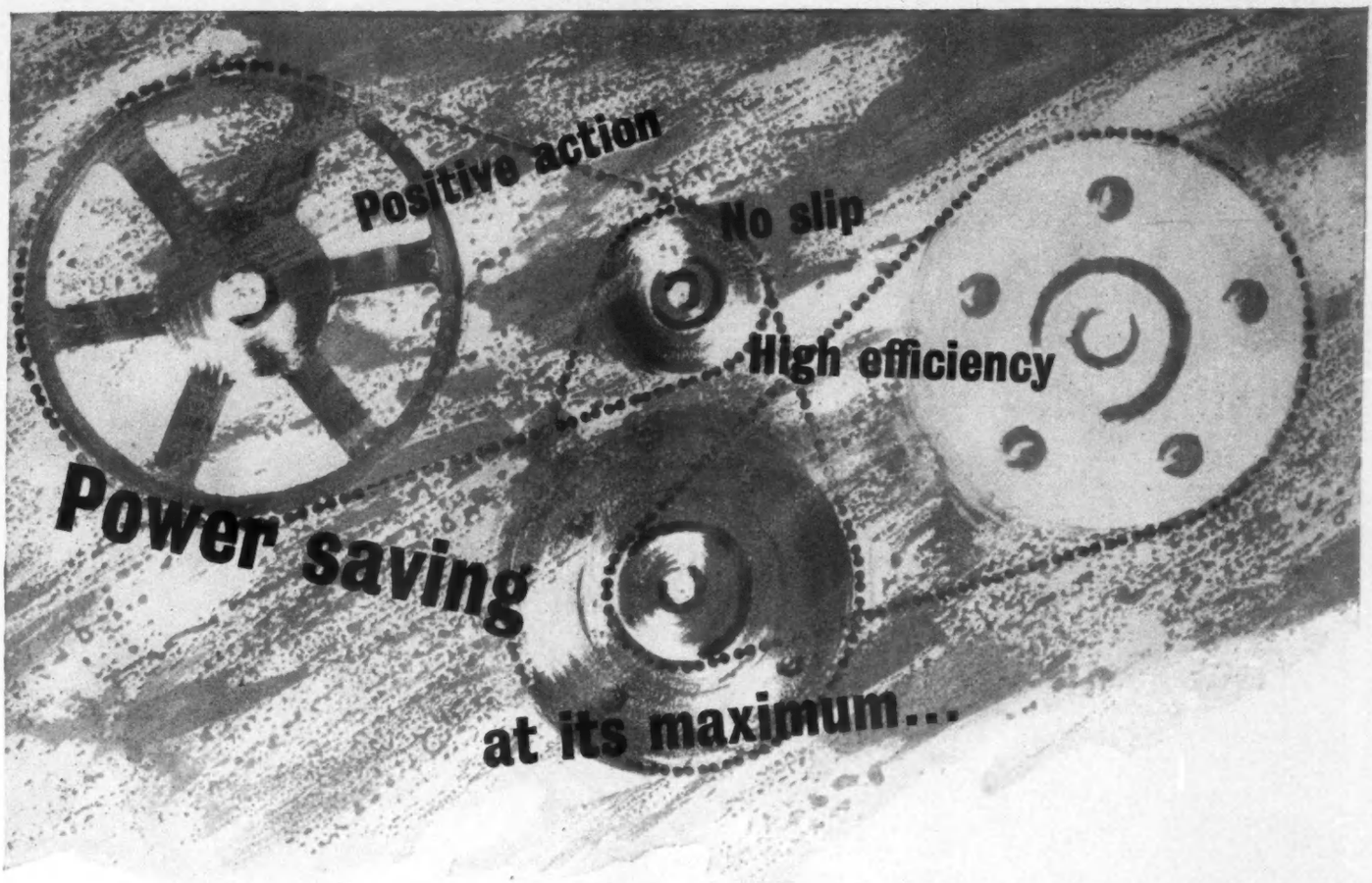

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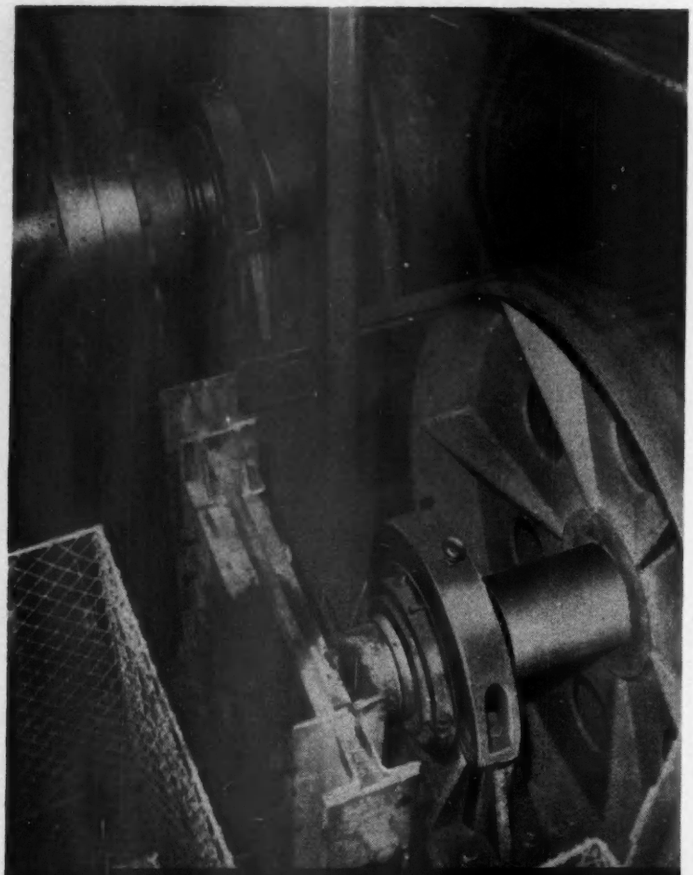

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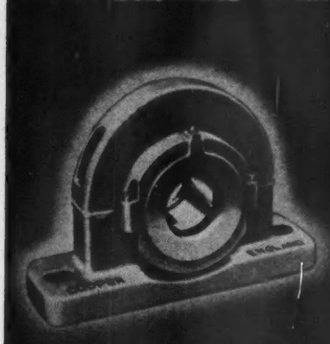

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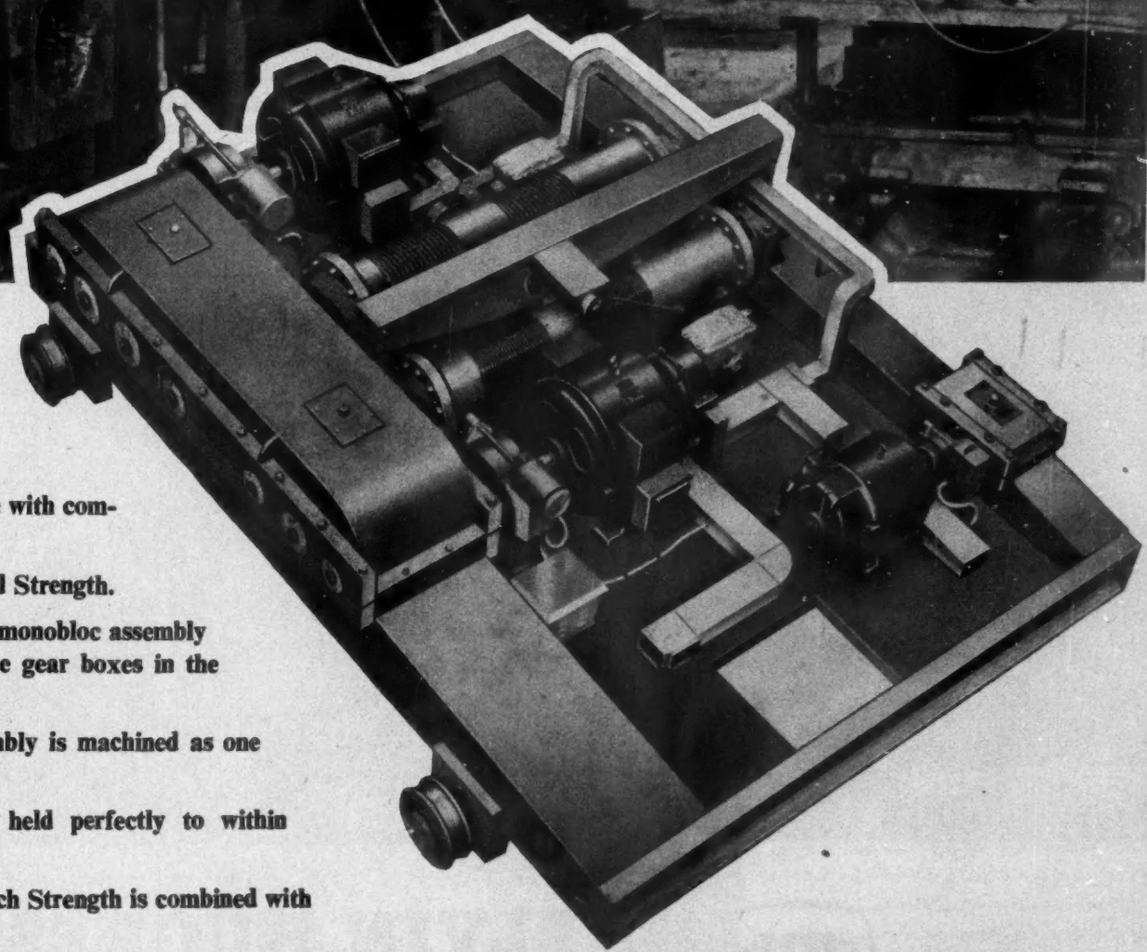

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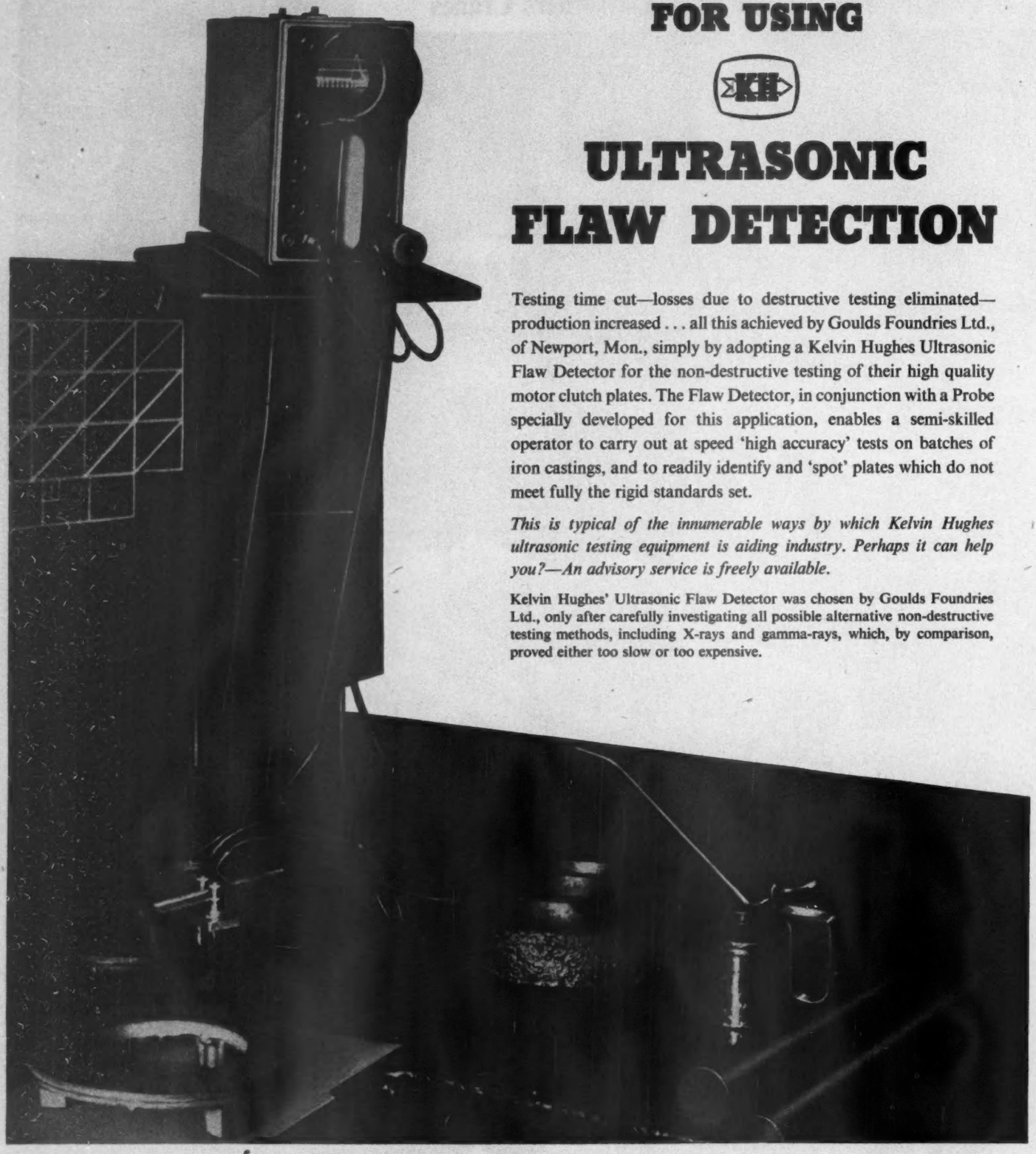

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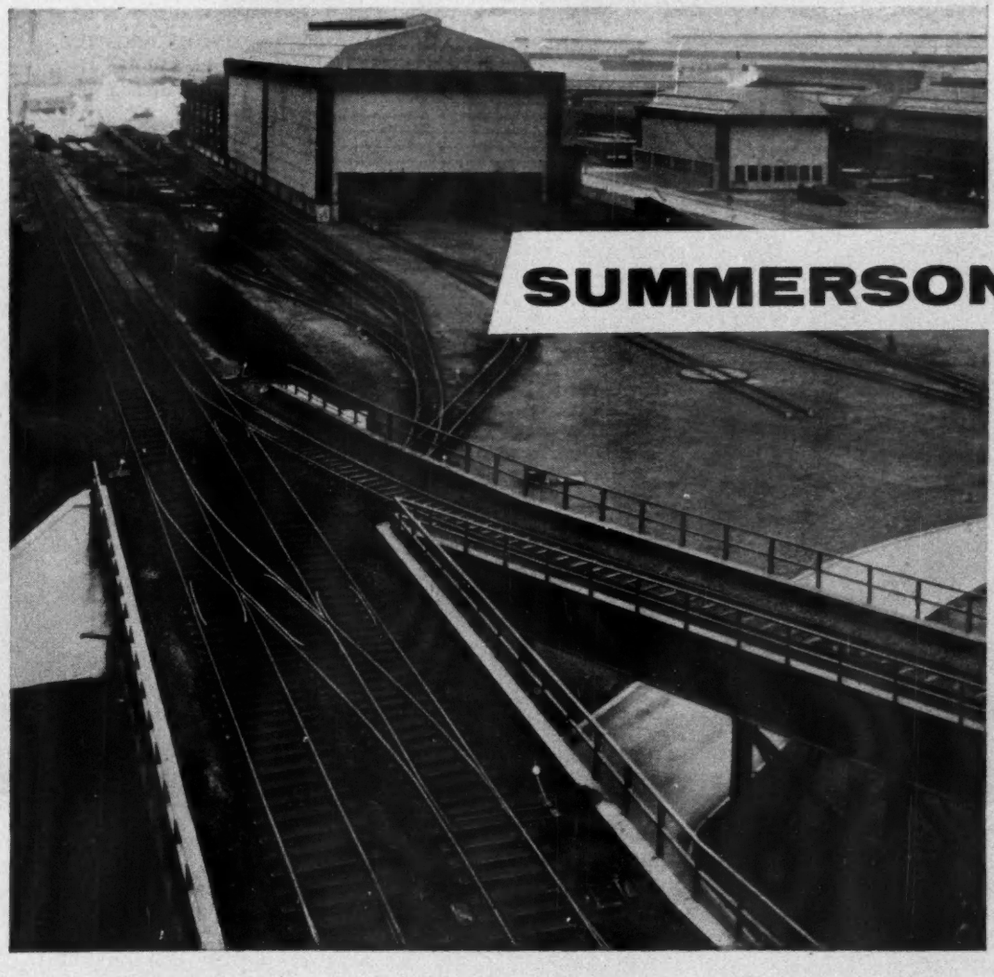

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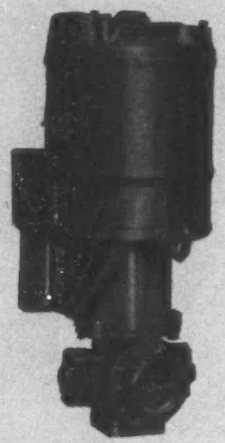

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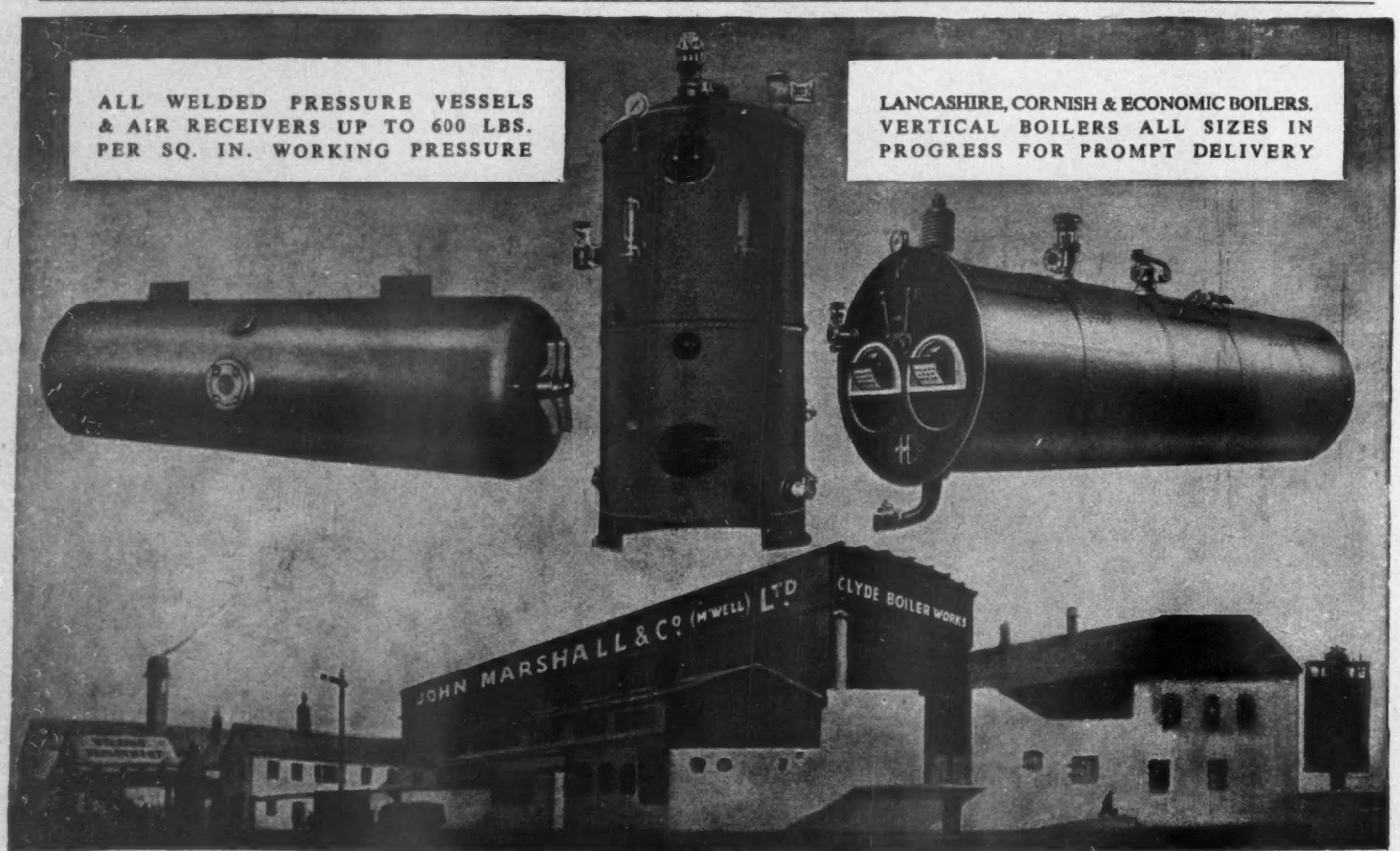

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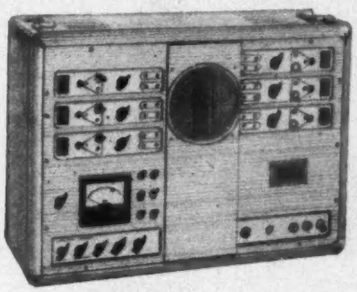
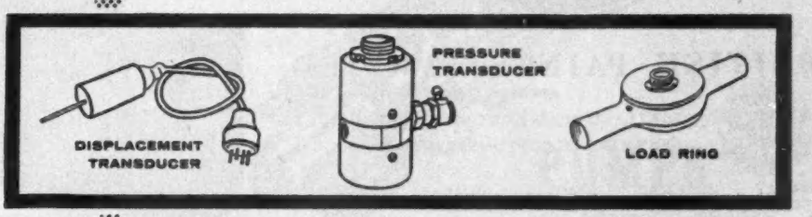
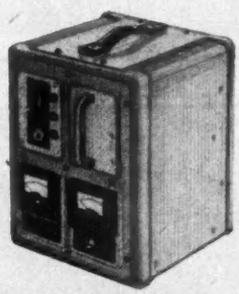


6 CHANNEL C.R.T. FILM RECORDER





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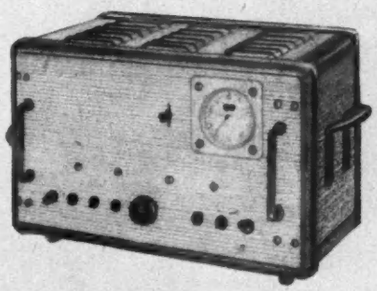

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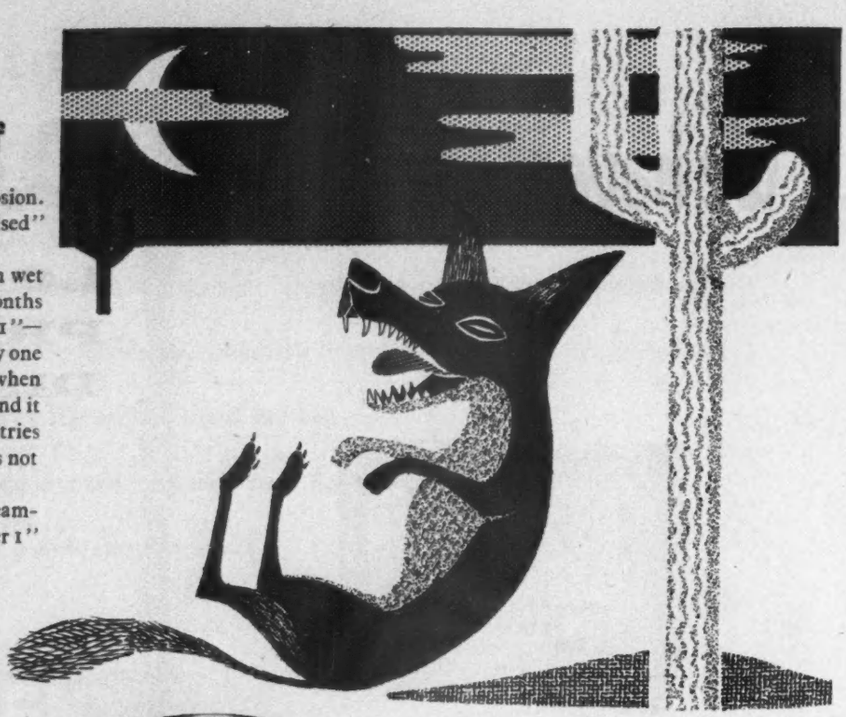
He would try to laugh it off



But steam engineers can't afford to laugh at boiler corrosion. It can be an expensive business—unless they have "Apexiorised" at the beginning.

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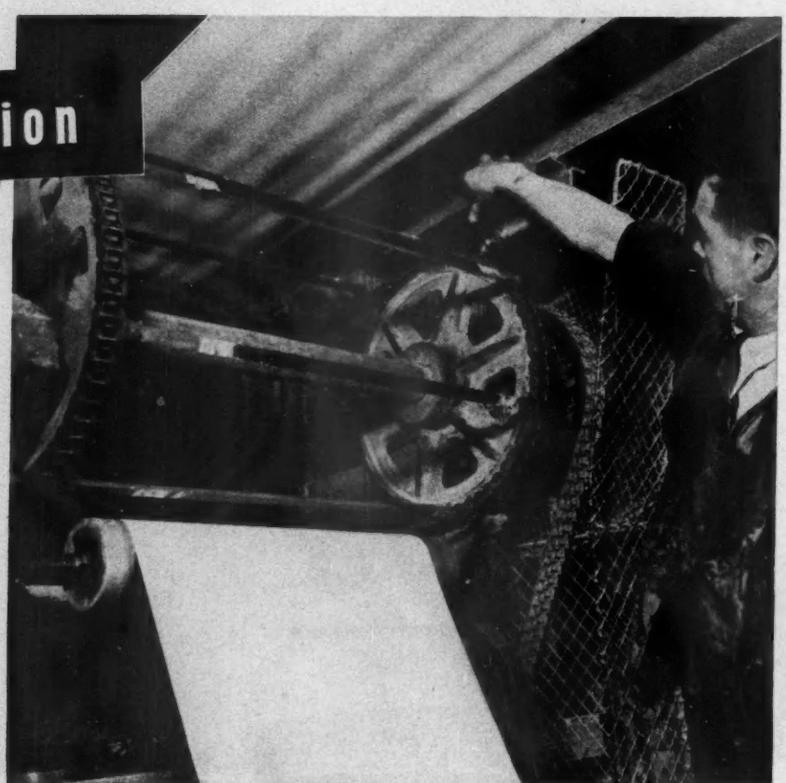

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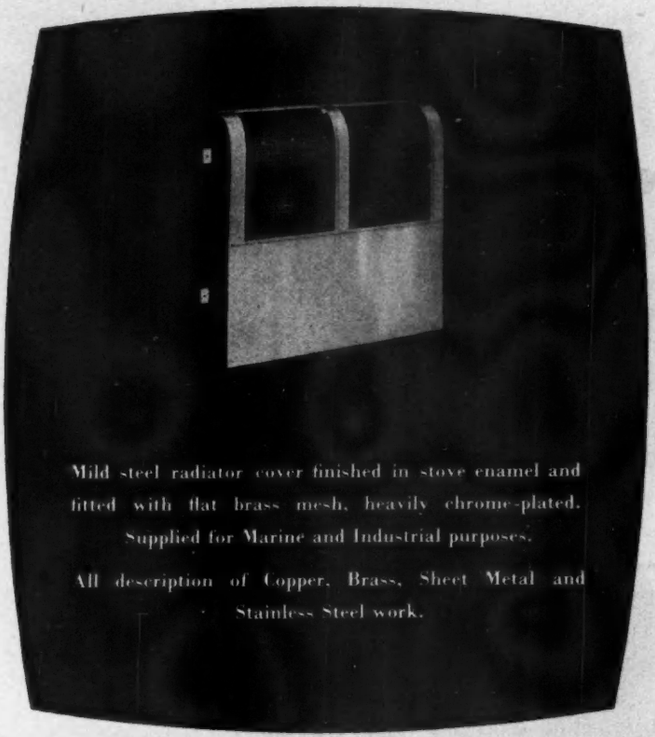

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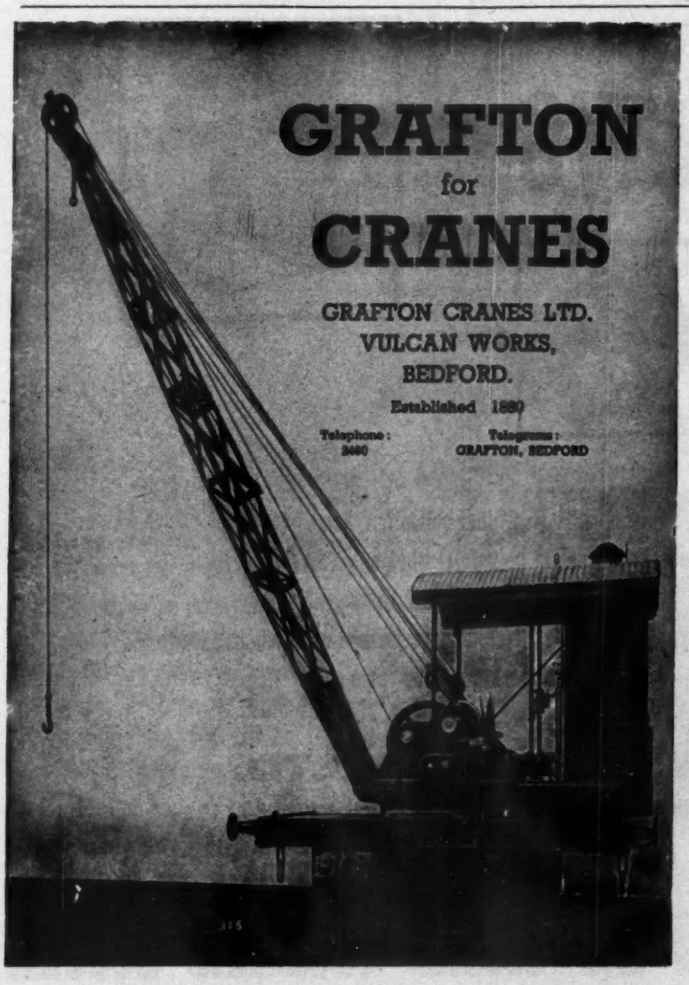

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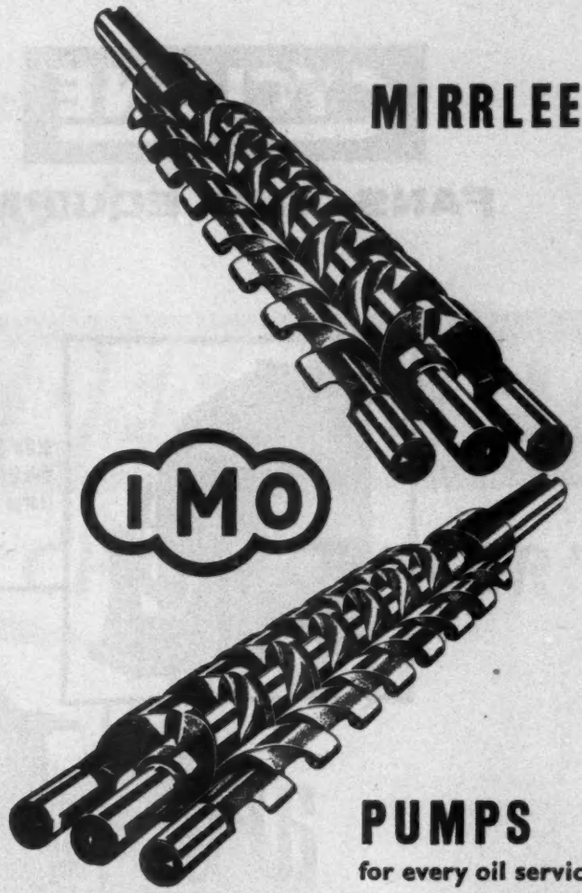

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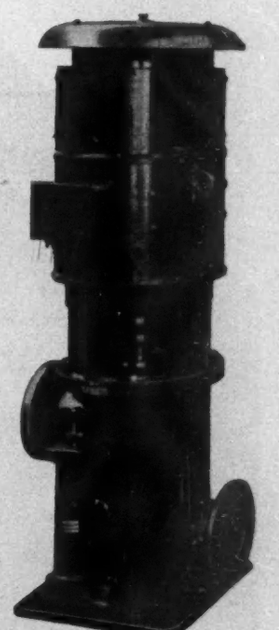

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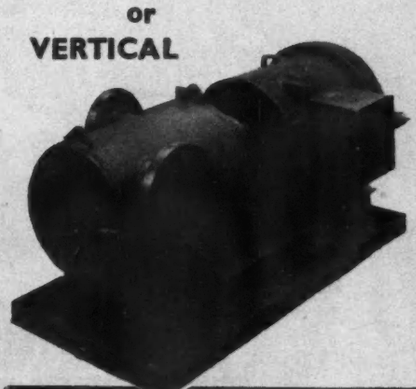

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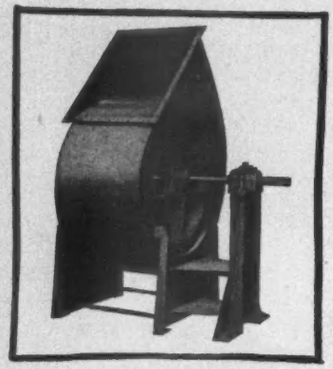
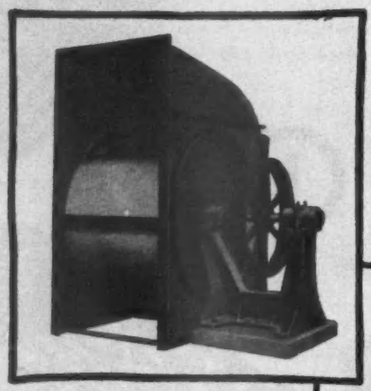


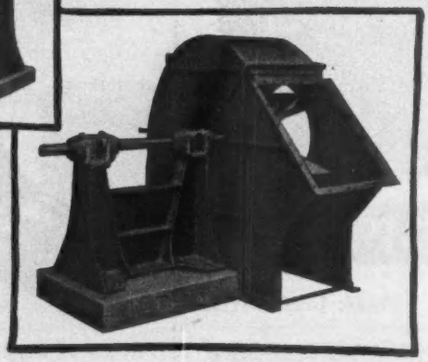
SLOW SPEED MULTIVANE FAN (Intermediate size).



SLOW SPEED MULTIVANE FAN (Large size).

Air ways

are



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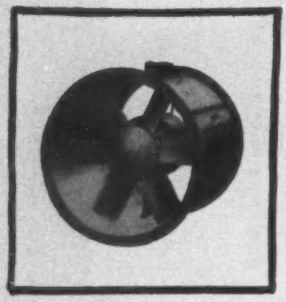

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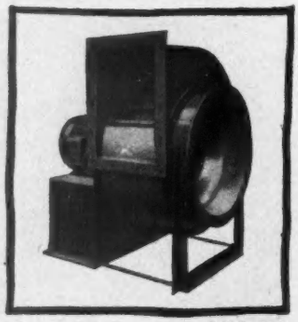
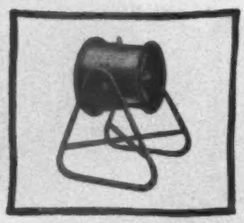


P.V.C. FAN.



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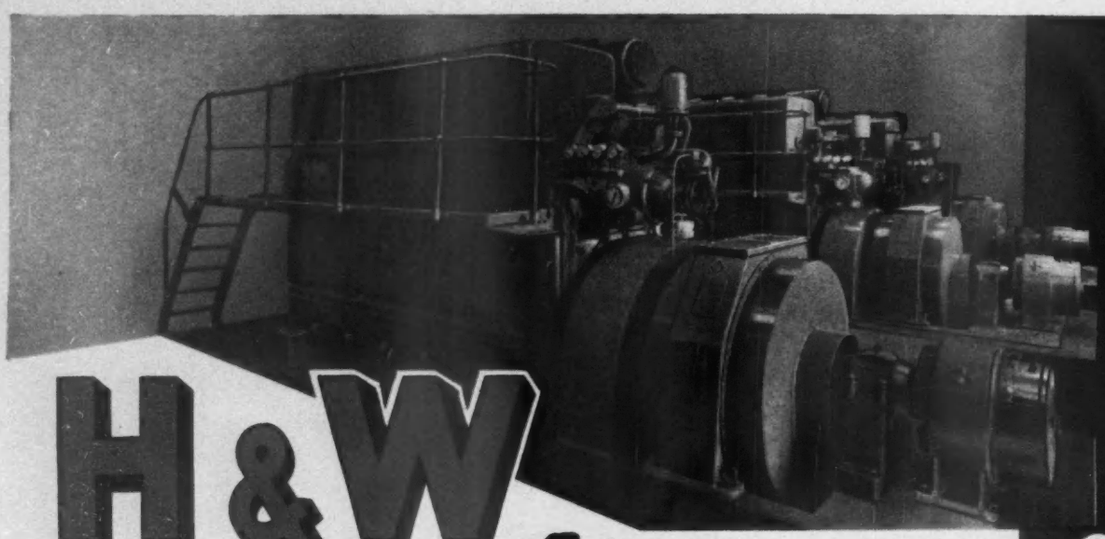

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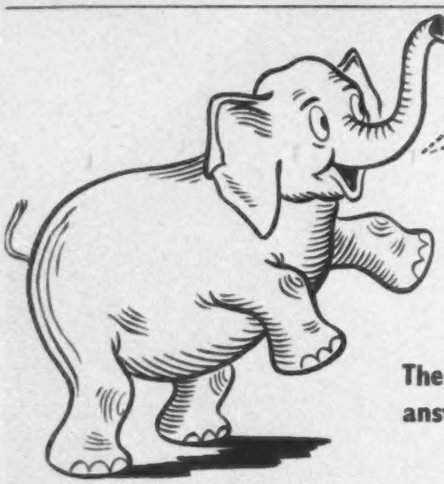

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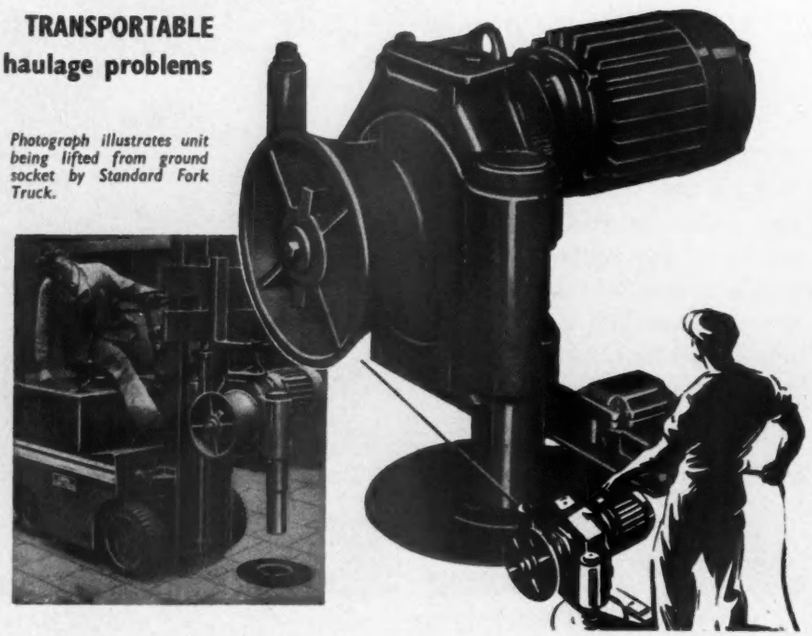

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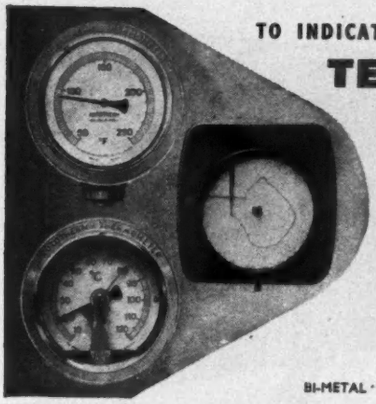

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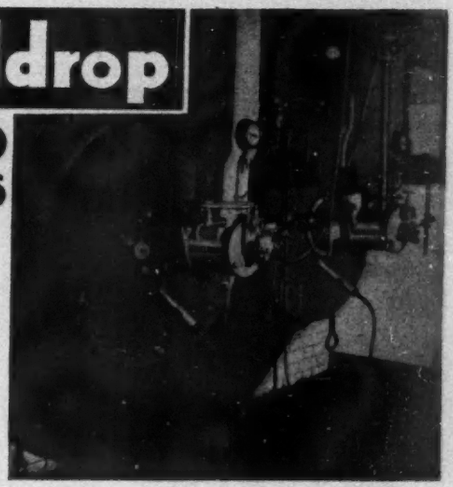

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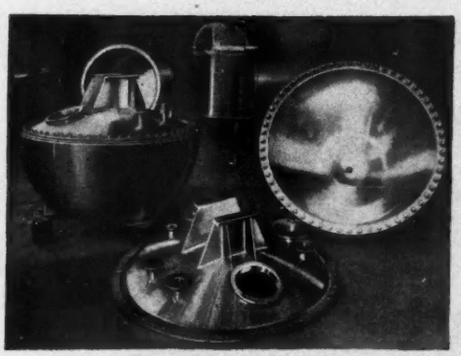
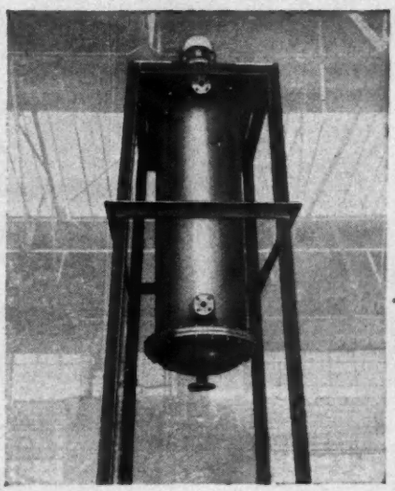


Hemi-spherical Mixing Vessels with polished covers and interiors.



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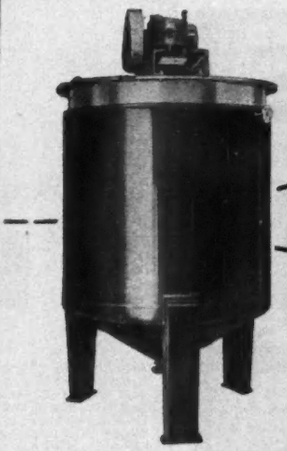
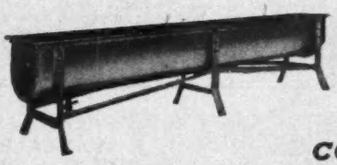
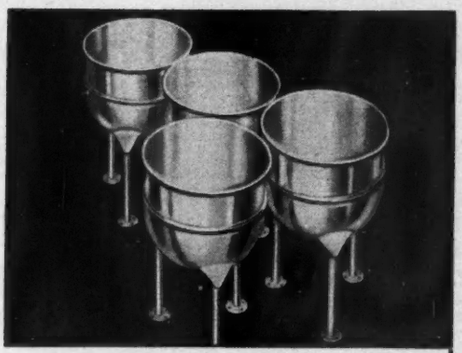


Mixer—Motor driven through gear box. Propellor type mixing elements. M.S. Steam jacket.



Soaking Trough for Brewery.



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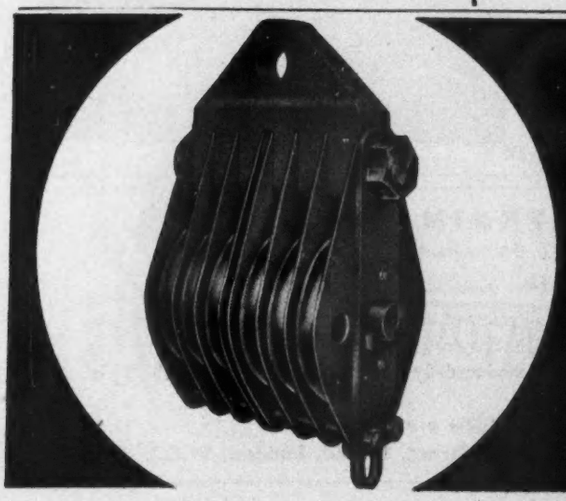

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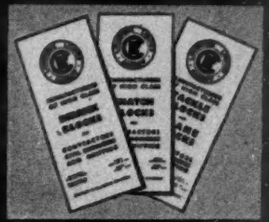

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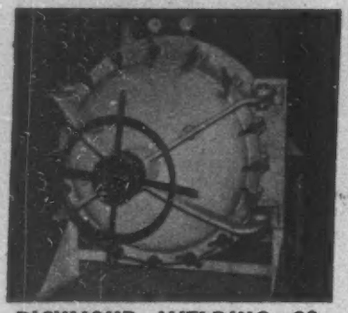

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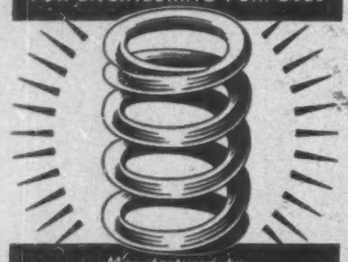

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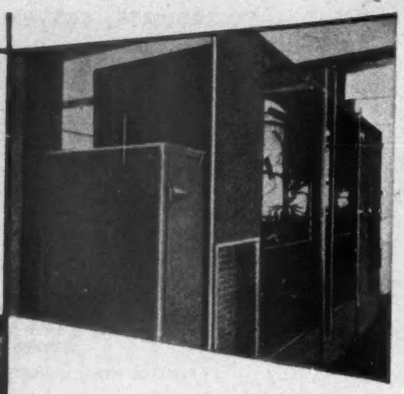

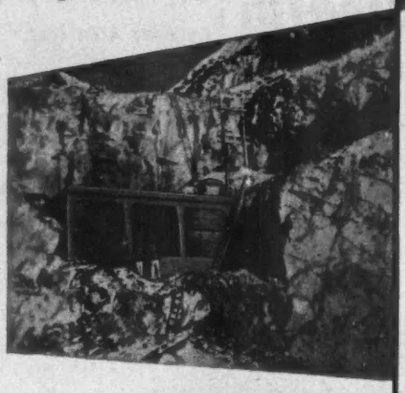

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★ *The photographs show a 300 kW. Hewittic Rectifier substation in mining traction service in Mexico.*

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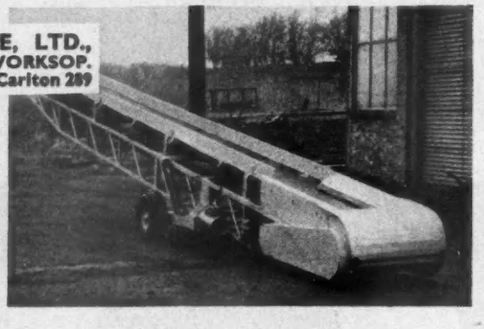
ARGENTINA: H. A. Roberts & Cia., S.R.L., Buenos Aires. AUSTRALIA: Hackbridge and Hewittic Electric Co. Ltd., 171, Fitzroy Street, St. Kilda, Victoria; N.S.W.: Queensland: W. Australia: Elder, Smith & Co. Ltd.; South Australia: Parsons & Robertson Ltd.; Tasmania: H. M. Bamford & Sons (Pty.) Ltd., Hobart. BELGIUM & LUXEMBOURG: Pierre Pollie, Brussels 3. BRAZIL: Oscar G. Mors, Sao Paulo. BURMA: Neonlite Manufacturing & Trading Co. Ltd., Rangoon CANADA: Hackbridge and Hewittic Electric Co. of Canada Ltd., Montreal; The Northern Electric Co. Ltd., Montreal, etc. CEYLON: Envee Ess Ltd., Colombo. CHILE: Sociedad Importadora del Pacifico Ltda., Santiago. EAST AFRICA: Gerald Hoe (Lighting) Ltd., Nairobi. EGYPT: Giacomo Cohenca Fils, S.A.E., Cairo. FINLAND: Sähkö-ja Koneliike O.Y. Hermes, Helsinki. GHANA, NIGERIA & SIERRA LEONE: Glyndova Ltd. GREECE: Charilaos C. Coroneos, Athens. INDIA: Steam & Mining Equipment (India) Private Ltd., Calcutta; Easun Engineering Co. Ltd., Madras, 1. IRAQ: J. P. Bahoshy Bros., Baghdad. MALAYA, SINGAPORE & BORNEO: Harper, Gilfillan & Co. Ltd., Kuala Lumpur. NETHERLANDS: J. Kater E.I., Ouderkerk a.d. Amstel, NEW ZEALAND: Richardson, McCabe & Co. Ltd., Wellington, etc. PAKISTAN: The Karachi Radio Co., Karachi 3. SOUTH AFRICA: Arthur Trevor Williams (Pty.) Ltd., Johannesburg, etc. CENTRAL AFRICAN FEDERATION: Arthur Trevor Williams (Pty.) Ltd., Salisbury. THAILAND: Vichien Phanich Co. Ltd., Bangkok. TRINIDAD & TOBAGO: Thomas Peake & Co., Port of Spain. TURKEY: Dr. H. Salim Oker, Ankara. U.S.A.: Hackbridge and Hewittic Electric Co. Ltd., P.O. Box 234, Pittsburgh 30, Pennsylvania. VENEZUELA: Oficina de Ingenieria Sociedad Anonima, Caracas.



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By J. YARNELL, B.Sc., A.Inst.P.

Price 12s. 6d. *(Postage 6d.)*

This book deals with the construction and application of resistance strain gauges and with the most commonly used circuits and apparatus. The strain gauge rosette, which is finding ever wider application, is treated extensively, being introduced by a short exposition of the theory of stress and strain in a surface.

Order your copy through your Bookseller or direct from:—

ELECTRONIC ENGINEERING, 28, Essex Street, Strand, London, W.C.2.

We can design and build almost any sort of plant for almost all conditions using stainless steel and other alloys

HOT, COLD, CORROSIVE

• Centrifugal Fans • Jacketed pans for starch • Heat exchangers for Atomic energy projects
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Hear people called here the other day
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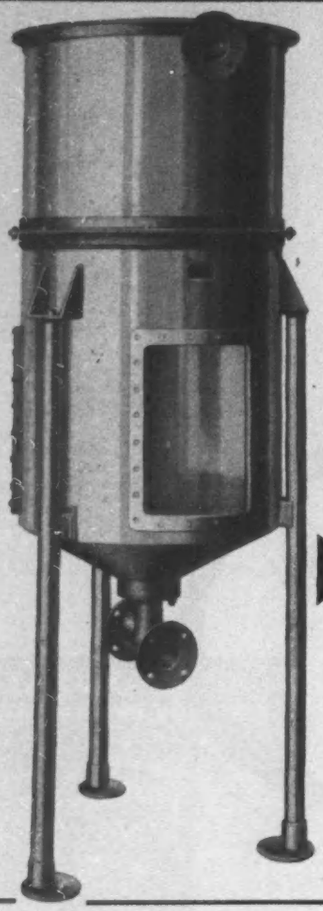
FOR FABRICATION IN STAINLESS STEEL & NICKEL ALLOYS



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Series 500 and series 700 A.C. Solenoids are available in Flame Proof enclosing cases, certified to Buxton standards.

Your production processes can be made more efficient by fitting Westool Solenoids to your machines. Why? Because Westool Solenoids are compact, self-contained electro-magnetic units which provide a direct mechanical action automatically or by remote push-button control. No gear trains, no complicated mechanisms—just simple electrical wiring from the control panel to the "on-the-spot" Solenoid actuator. Westool Solenoids lift, lower, push, pull, open or shut, and thus simplify machine designs, speed up operations and reduce production costs. There is a long and diverse list of machinery which has already been improved by solenoid control—you can add yours to the list with advantage.

To meet customers' immediate requirements, Westool carry some 10,000 solenoids of various types and ratings so that your immediate needs may be dealt with by return.

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WESTOOL LIMITED

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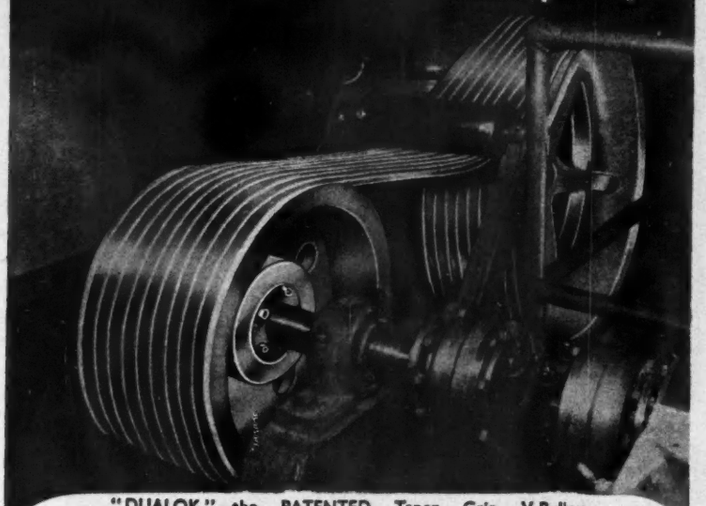
Phone: West Auckland 551/5 Grams: Solenoid, West Auckland
Birmingham Office: 7 Newhall Street, Birmingham 3. Phone: Central 3901
Westool also make Coils & Coil Winding Machines, Transformers, Warner Electric Brakes & Clutches, Air Conditioners, etc.

TIB 94

Here is Proof! 65 H.P. Pulsating Drive . . . . . without a keyway.



"DUALOK"—the PATENTED Taper Grip V-Pulley

1 Only DUALOK has the patent TWIN Bush for DOUBLE-GRIP. Simple, safe, easy to fit.
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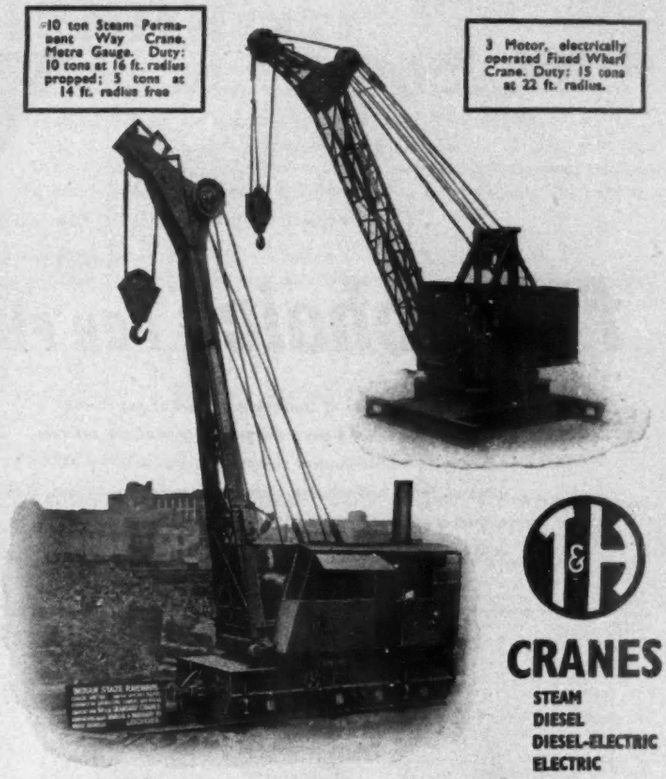
10 ton Steam Permanent Way Crane. Metre Gauge. Duty: 10 tons at 16 ft. radius propped; 5 tons at 14 ft. radius free

3 Motor, electrically operated Fixed Wharf Crane. Duty: 15 tons at 22 ft. radius.



T&H

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SOLID STEEL DROP FORGED

all sizes from ¼" to 3" whit.

ARMSTRONG STEVENS & SON LTD.
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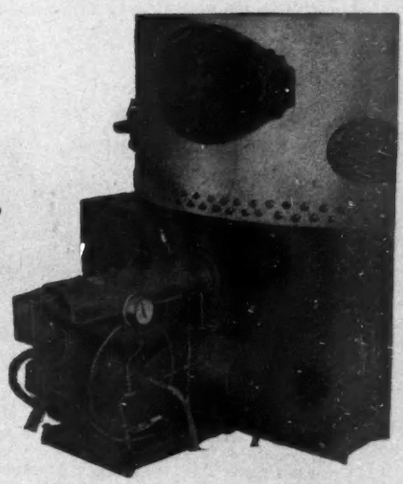
PRIOR OIL BURNERS

Available in ten sizes for heat outputs of 50,000 to 4,000,000 BTUs/HR for use with light, 200 or 950 seconds oil, depending on capacity.



'SH' model burner applied to a 6' 6" diameter and 15' 9" high Cochran Steam Boiler, which is fired with a combustion efficiency of 84%.

- *efficient*
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- *economical*
- *clean*
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- *labour-saving*
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STOKERS LIMITED

MANUFACTURERS OF OIL BURNERS AND UNDERFEED STOKERS

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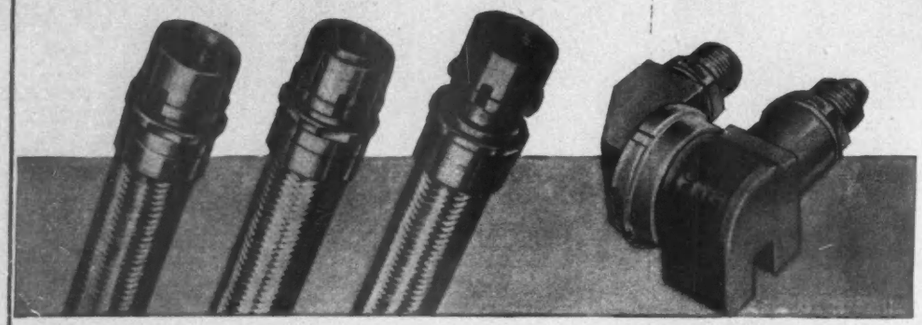
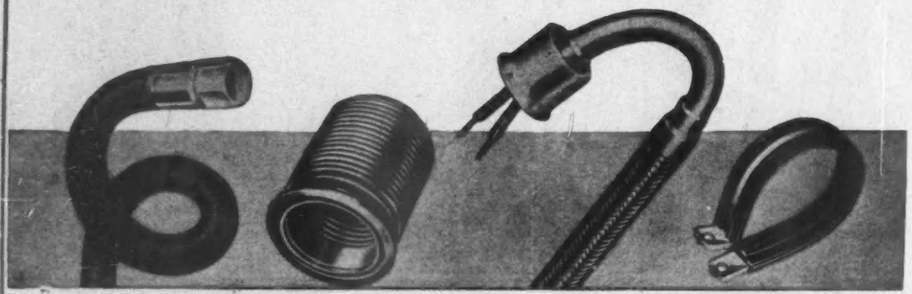
first choice FOR FLUID MOVEMENT

When it's a question of conveying a liquid or gas through a movable pipe, AVICA know the problems—and the answers. AVICA pipe assemblies and components are made for all kinds of duties and to work under the toughest conditions, such as extremes of temperature and pressure, corrosive atmospheres, continuous vibration. Above all, they are absolutely dependable.



STAINLESS STEEL FLEXIBLE PIPE ASSEMBLIES
For most corrosive liquids and gases at temperatures from —183°C. to 450°C. Sizes from 3/16" to 4". End couplings of many types.

SWIVEL PIPE COUPLINGS
Used with rigid pipe when a flexible pipe is not suitable. Sizes 1/4", 3/8" and 1/2". For hydraulic and other fluids at pressures up to 4000 p.s.i.



SYNTHETIC RUBBER FLEXIBLE PIPE ASSEMBLIES
Used to carry petrol, oil, air steam, hydraulic fluids, or machine tools, hydraulic presses, mining equipment at pressures up to 5000 p.s.i. Size range (i.d.) 5/32" to 2". Temperature range—40°C. to 160°C.

STAINLESS STEEL BELLOWS ASSEMBLIES
Take up thermal expansion and contraction in rigid pipes and ducts, also changes due to pressure variation. Used as seals in valves and pressure regulators. For temperatures up to 450°C.

WIRING HARNESS
Electrical wiring protected by rigid or flexible conduit from heat, oil, moisture and vibration.

SUPPORT CLAMPS
To hold piping and electrical cables. The rubber cushion absorbs vibration, can be replaced when worn or perished.

Illustrated leaflets describing the full range of AVICA products are available on request. Please write for those that interest you.

AVICA

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AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS

Lineage Rate. 4/- per line of approximately 6 words. Minimum 16/-.

Inch Rate. 48/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

AUCTION SALES · FOR HIRE · MACHINERY, etc., WANTED · SITUATIONS WANTED DRAWING AND DESIGN SERVICES · FOR SALE · SUB-CONTRACTING

Lineage Rate. 3/6 per line of approximately 6 words. Minimum 14/-.

Inch Rate. 42/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £22. ½-page £41 10s. Full page £78.

Series Discounts. For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/- which includes forwarding of replies.

Copy Dates. "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to:*—Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

Urgent advertisements may be telephoned to CENtral 6565.

PUBLIC APPOINTMENTS

NOTTINGHAM AND DISTRICT TECHNICAL COLLEGE

BURTON STREET, NOTTINGHAM

Principal: D. A. R. CLARK, M.Sc.(Tech.), M.I.Mech.E.

LECTURERS

Applications are invited for the following posts:

(a) SENIOR LECTURER IN THEORY AND DESIGN OF MACHINES. Experience with Servo-Mechanism Design would be advantageous.

(b) LECTURER IN MECHANICAL ENGINEERING—preferably with ability to teach Thermodynamics.

In both cases the person appointed should be prepared to undertake or supervise research work as part of his teaching programme.

Salary in accordance with the Burnham Technical Scale as follows:

Senior Lecturer: £1350 rising by annual increments of £50 to £1550 per annum.

Lecturer: £1200 rising by annual increments of £30 to £1350 per annum. A salary above the minimum will be paid in approved cases.

Further particulars and form of application may be obtained from the Principal, to whom completed forms should be returned not later than 15th August. E8128

CARMARTHENSHIRE EDUCATION COMMITTEE

AMMANFORD TECHNICAL COLLEGE

FULL-TIME ASSISTANT MASTER

Applications are invited for the post of FULL-TIME ASSISTANT MASTER in Engineering Subjects (Mechanical and Electrical) at the above-named College.

Candidates should be Graduates in Engineering or possess qualifications of an equivalent standard and have had suitable Industrial experience (preferably Mining) and teaching experience.

Salary in accordance with the Burnham Further Education Report for Grade B assistants (£650 by £25 to £1025) with additions for degree, approved training and previous experience.

Duties to commence as soon as possible.

Forms of application which must be returned not later than 9th August, 1958, may be obtained from the undersigned on receipt of a stamped, addressed envelope.

IORWERTH HOWELLS, Director of Education.

Education Department, County Hall, Carmarthen. E1808

SINGAPORE POLYTECHNIC

(Principal: D. J. WILLIAMS, M.A., B.Sc., F.R.I.C.)

ASSISTANT LECTURERS

The Board of Governors invite applications for the following posts:

(a) ASSISTANT LECTURER (Grade II), Mechanical/Electrical.

(b) ASSISTANT LECTURER (Grade III) Motor Vehicle Mechanics.

Qualifications: (a) Higher National Certificate or a degree in Mechanical or Electrical Engineering; teaching and/or industrial experience desirable.

(b) Motor Vehicle Technicians Certificate of City and Guilds, or equivalent; good industrial experience essential; teaching experience desirable.

Salary Scales (incorporating all allowances):

Assistant Lecturer Grade II M$1000–M$50–M$1350 per month.

Assistant Lecturer Grade III M$1200–M$50–M$1550 per month.

(One Malayan Dollar—2s. 4d. Sterling.)

Appointments of overseas persons will be on contract for 3 years. Favourable Endowment Insurance Scheme; or arrangements to continue F.S.S.U. policy will be considered. Accommodation, with heavy furniture, at a rental of M$ 120/- per month; free medical attention; free passages for overseas member of staff, wife and up to 3 children under 18, on first appointment, leave, and completion of service; home leave at the rate of 60 days per year's service to be taken at the end of contract.

Application forms (4 copies) and further information obtainable from the Council for Overseas Colleges, 12, Lincoln's Inn Fields, London, W.C.2. Closing date 11th August, 1958. E8114

PUBLIC APPOINTMENTS

UNIVERSITY OF MANCHESTER

RADIO TELESCOPE

DUTY CONTROLLER

A vacancy exists for a post of DUTY CONTROLLER in connection with the 250ft. steerable radio telescope at the Jodrell Bank Experimental Station of the University of Manchester. The commencing salary, which will depend on qualifications and experience, will not exceed £650 per annum, but will be subject to review later.

The radio telescope is driven by remote control and the person appointed will be required to work on a shift basis in the control room of the telescope. Under normal conditions the duties will include the simple following of operating instructions as determined by the research programmes, but quick judgement may be necessary when emergencies arise. The duties include the routine maintenance of the electronic control equipment and instrumentation in the control room. Candidates must be physically fit, with good eyesight, and be capable and willing to work on a shift basis to cover the 24 hours. They must be capable of keeping full, accurate and tidy records relating to the duties entrusted to them. Candidates must hold a Higher National Certificate in Electrical Engineering, or a senior City and Guilds Certificate in some branch of light current electrical engineering or similar qualifications. Previous experience of the control of plant or apparatus containing both electrical and mechanical parts is desirable.

Applications, giving full details of qualifications and experience as well as the names and addresses of two referees, should be sent to Professor A. C. B. Lovell, Director, Jodrell Bank Experimental Station, Lower Withington, Macclesfield, Cheshire. E8094

MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY

SENIOR TECHNICIAN

A vacancy exists in the Structural Engineering Department of the College for a SENIOR TECHNICIAN in connection with a proposed computing service for structural engineers.

Duties will include the coding and preparation of data tapes and the operation of the Mercury computer at Manchester University. The successful candidate should have a good structural background; a knowledge of computing is not necessary.

Salary within the Senior Technician's Grade £670–£715.

Applications giving full details to be sent to the Chief Engineer and Works Superintendent, The Manchester College of Science and Technology, Manchester, 1. E8081

UNIVERSITY OF SYDNEY, AUSTRALIA

LECTURESHIP IN ARCHITECTURAL SCIENCE

Applications are invited for the above position, within the Faculty of Architecture. Applicants should preferably have an Honours Degree in Architecture, in Civil, Mechanical or Electrical Engineering, or in Physics.

The salary for a Lecturer is within the range £A1500 by £A90 to £A2100 per annum, plus cost of living adjustment and will be subject to deductions under the State Superannuation Act. The commencing salary will be fixed according to the qualifications and experience of the successful applicant.

Under the Staff Members' Housing Scheme in cases approved by the University and its Bankers, married men may be assisted by loans to purchase a house.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1.

The closing date for the receipt of applications, in Australia and London, is 30th September, 1958. E8082

COUNTY OF LEICESTER

MECHANICAL ENGINEER £750–£1030

Initial salary according to qualifications and experience. Candidates must be experienced in the installation and maintenance of laundry machinery and mechanical plant with some knowledge of design of heating schemes. Possession of H.N.C. or A.M.I.Mech.E., an advantage. Temporary lodging allowance and removal expenses may be paid to a married man.—Apply by 27th August on forms obtainable from County Architect, 123, London Road, Leicester. E8087

PUBLIC APPOINTMENTS

SOUTH-EAST ESSEX TECHNICAL COLLEGE

LONGBRIDGE ROAD, DAGENHAM, ESSEX

HEAD OF ENGINEERING DEPARTMENT

Applications are invited for the post of HEAD OF THE MECHANICAL AND PRODUCTION ENGINEERING DEPARTMENT (Grade V). Candidates should have high academic qualifications, together with teaching and industrial experience. The appointment will date from 1st January, 1959, or earlier if possible.

Salary: £1900 by £50 to £2050, plus London allowance.

Application forms and further details (stamped addressed foolscap envelope) obtainable from the Chief Education Officer, County Offices, Chelmsford. Closing date 16th August, 1958. E8127

NATIONAL COAL BOARD

NORTH EASTERN DIVISION

CIVIL ENGINEERING ASSISTANT

CIVIL ENGINEERING ASSISTANT required as Resident Engineer at Grimethorpe Colliery. Salary range £900 to £1400 or £1050–£1600.

The successful applicant will be responsible for the supervision of heavy Civil Engineering works in connection with Colliery Reconstruction Projects.

Experience in foundations, reinforced concrete and steel structures, earthworks, drainage, railways and roads, and good knowledge of relevant Conditions of Contract essential. Related design experience desirable. Corporate Members of Institution of Civil Engineers or Graduate Members to qualify in two years preferred.

Apply giving details of age, education, &c., to Area Staff Manager, No. 4 Area, Grimethorpe, Near Barnsley, by the 5th August, 1958.

Mark envelopes Staff Vacancy. E8099

BIRMINGHAM REGIONAL HOSPITAL BOARD

APPOINTMENT OF REGIONAL ENGINEER

Wide experience essential in design and operation of engineering plant, especially of heating, hot water and ventilating systems, preferably in hospitals or large undertakings. Essential qualifications: Corporate Membership of Institutions of Civil, Mechanical or Electrical Engineers or appropriate engineering appointment of professional grade in hospital service. REGIONAL ENGINEER will be whole-time officer responsible to Board for efficient working of his department; salary £1885 by £80 (1) by £85 (4) by £50 (1) to £2355. Further particulars from Secretary, Regional Hospital Board, 10, Augustus Road, Birmingham, 15. Applications naming three referees to be received by 1st September, 1958. Interviews mid-September. E8103

CITY OF LIVERPOOL

WATER DEPARTMENT

ASSISTANTS

Applications are invited for the appointment of two ASSISTANTS (CIVIL ENGINEERING), (a) for the Vyrnwy Aqueduct and Works, under the Resident Engineer, Oswestry, (b) for the Drawing-Office Staff, Liverpool. Salary £575–£1030 per annum, according to qualifications and experience (A.P.T. I—Special N.J.C. Scale).

Applicants must either have been trained as a civil engineer and have passed Parts I and II of the Examination of the Institution of Civil Engineers (or hold the necessary exempting qualifications), or hold a suitable Degree of a British University. Experience in the construction or design of works of water supply an advantage.

Application forms (returnable by 31st July, 1958) from the Water Engineer, 55, Dale Street, Liverpool, 2. The appointments are superannuable and subject to the Standing Orders of the City Council. Canvassing disqualifies.

THOMAS ALKER, Town Clerk.

(J.5266) E8000

PUBLIC APPOINTMENTS

SOUTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

ASSISTANT ENGINEERS

Applications are invited for the following appointments on the permanent staff of the Board's Regional Engineer generally in accordance with the Whitley Council conditions of service. (Headquarters moving later this year to Paddington.)

ASSISTANT ENGINEER (MECHANICAL): Applicants should have served a recognised engineering apprenticeship and must be Graduate members of the Institution of Mechanical Engineers, and have passed A and B of the Associate Membership examination, or hold exempting qualifications. Corporate membership of the Institution of Heating and Ventilating Engineers will qualify. Sound experience of design of mechanical services of large buildings required. Drawing Office and Estimating experience an advantage.

ASSISTANT ENGINEER (ELECTRICAL): Applicants should have passed the Institution's examination, and be a Graduate Member of the Institution of Electrical Engineers, and should be experienced in the preparation of specifications, drawing and estimates for electrical installations in hospitals and large public buildings.

Salary: £700 by £25 (3) by £30 (1) by £35 (6) to £1015 per annum. The commencing point may be fixed above the minimum of the scale for relevant practical experience.

Application forms may be obtained from the undersigned at 11a, Portland Place, W.1, and must be returned completed by not later than 5th August.

E. G. BRAITHWAITE, Secretary. E8125

ROYAL NAVAL SCIENTIFIC SERVICE

SENIOR SCIENTIFIC OFFICERS AND SCIENTIFIC OFFICERS

Royal Naval Scientific Service requires SENIOR SCIENTIFIC OFFICERS and SCIENTIFIC OFFICERS for Establishments in London area, Baldock, Portsmouth, Portland, Poole, Greenock and Rosyth. Main requirements are about 25 vacancies for PHYSICISTS, ELECTRONIC ENGINEERS and MATHEMATICIANS in areas specified. The following particular vacancies also exist: MECHANICAL ENGINEER for work on gas turbine problems in the London area. MECHANICAL ENGINEER for work on design and development of U/W devices in Portland area. METALLURGISTS for Rosyth and Poole. CHEMISTS (Physical and Inorganic) for Poole area, Baldock and London. Candidates must normally be natural born British subjects of natural born British parents, with at least First or Second Class Honours degrees or equivalent high professional attainments. S.S.O.s must have had at least three years' post-graduate experience and be not less than 26 years of age. Salaries (men) S.S.O. £1190–£1410; S.O. £635–£1110 (London)—somewhat lower in provinces. Appointments unestablished (with F.S.S.U. benefits), but opportunities may occur for those between the ages of 21 and 32 to compete for established posts.—Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting A98/58A. E8092

LIVERPOOL REGIONAL HOSPITAL BOARD

ASSISTANT ENGINEER

ASSISTANT ENGINEER (Electrical) required on the staff of the Regional Engineer.

Applicants should have passed the Institution examination and be Graduate Members of the Institution of Electrical Engineers; be experienced in the preparation of specifications, drawings and estimates for distribution schemes, electrical installations in hospitals and buildings and be able to take details of existing installations and have a good knowledge of modern installation practice.

Salary scale: £700–£1015 per annum. Starting salary depending on age and previous relevant practical experience.

Applications, stating age, qualifications, experience, present and previous appointments, with names and addresses of three referees (two technical), to reach me at 55, Castle Street, Liverpool, 1, by 5th August, 1958.

VINCENT COLLINGE, Secretary to the Board.

E7986

Classified Advts. continued on page 108

PUBLIC APPOINTMENTS

CROWN AGENTS FOR OVERSEA GOVERNMENTS AND ADMINISTRATIONS

LONDON OFFICE

ASSISTANT ENGINEER (CIVIL)

ASSISTANT ENGINEER (CIVIL) required for their London Office by the Crown Agents for Oversea Governments and Administrations for appointment to pensionable establishment on probation for 2 years. Commencing salary between £595 p.a. at age 21, £805 at age 25 and £1085 at age 34 or over, in scale rising to £1250. Prospects of promotion. Fully qualified officers, at least 27 years of age may be eligible for special increase of £75 after 2 years' service. Liberal leave. Five-day week. Candidates must be Corporate members of the Institution of Civil Engineers or the Institution of Structural Engineers, or, if below the age of 28, must have passed Parts 1 and 2 of the Associate Membership examination of the Institution of Civil Engineers or hold an exempting degree, or have passed the Associate Membership examination of the Institution of Structural Engineers. They must be good draughtsmen and have had experience in the design of bridges, buildings or other structures in steel or reinforced concrete. Site experience an advantage. Candidates should be prepared to spend short periods on site surveys overseas, in which event special overseas allowances are payable.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/42637/EH. E8106

CENTRAL ELECTRICITY GENERATING BOARD

RESEARCH LABORATORIES

MECHANICAL ENGINEER

MECHANICAL ENGINEER required in the Mechanical Engineering Section of the Research Laboratories, Leatherhead, Surrey, to assist in research on the vibration and fatigue characteristics of steam turbine blading and heat exchanger tubing. The successful candidate will be required to design his own rigs and develop his own instrumentation. A man with both theoretical and practical engineering ability is required. Candidates should have a degree in engineering or equivalent and preferably some industrial experience. Salary within scales £820 to £995 or £1055 to £1265 per annum.

Applications stating age, qualifications, experience, present position and salary to S. S. Scott, Chief Personnel Officer, 24–30, Holborn, London, E.C.1, by 8th August. Envelopes should be marked "Confidential," quoting reference ENR/208. E8100

PRISON COMMISSION

WORMWOOD SCRUBS, LONDON, W.12

CIVILIAN INSTRUCTIONAL OFFICER

CIVILIAN INSTRUCTIONAL OFFICER, Engineering Fitter Machinist required for General Engineering Workshop, at H.M. Prison, Wormwood Scrubs, London, W.12.

Age at least 30 on 22nd August, 1958. Qualifications: full apprenticeship plus at least 5 years' industrial experience. Final City and Guilds certificate or equivalent, and some teaching experience desirable.

Salary £795–£920. 44-hour 5½-day week, generous paid holidays, pensionable appointment considered after a period of satisfactory service. Quarters not provided.

Write Prison Commission, R241/182, Horseferry House, Dean Ryle Street, London, S.W.1.

Closing date 8th August, 1958. E8093

PORT OF BRISTOL AUTHORITY

ENGINEERING ASSISTANTS

Applications invited for above posts. Duties mainly concerned with new works. Candidates should be capable of preparing schemes with minimum of supervision from initial survey through calculations and preparation of drawings to final contract documents. Experience in dock engineering useful, but not essential.

Salary £1025 by £50 p.a. to £1175. Commencing salary within this range will depend on age, qualifications and experience. Medical examination, six months' probationary period, post pensionable (Local Government Superannuation Act, 1953).

Applicants must disclose whether related to a member or senior officer of Bristol Corporation. Canvassing disqualifies.

Applications, stating age, qualifications, experience, &c., with, if possible, copies of recent testimonials, in envelope, endorsed "Engineering Assistants," to Engineer-in-Chief, Avonmouth Docks, Bristol, by 15th August, 1958. E8130

NATIONAL COAL BOARD

NORTH EASTERN DIVISION

SENIOR ENGINEERING DRAUGHTSMAN

SENIOR ENGINEERING DRAUGHTSMAN required for No. 6 (North Barnsley) Area. Salary range £775–£1035 per annum.

Applicants should preferably have had some experience in the design and development of mining machinery and equipment. The work is interesting and varied.

Apply to: Area Staff Manager, No. 6 (North Barnsley) Area, Ardsley House, Ardsley, Near Barnsley, by 28th July, 1958. E8078

PUBLIC APPOINTMENTS

WILTSHIRE COUNTY COUNCIL

PLANT SUPERINTENDENT

Applications invited for this post (salary £1025 by £50 to £1175 superannuable). To manage and control Central Repair Depot at Trowbridge for maintenance and servicing of highway and other plant. House available. Car required. A.M.I.M.E. desirable.

Application forms from County Surveyor, County Hall, Trowbridge, returnable by Monday, 18th August, 1958.

P. A. SELBORNE STRINGER,
Clerk of the Council.
E8123

BRITISH RAILWAYS

WESTERN REGION

ENGINEERING ASSISTANT

Applications are invited for the post of ENGINEERING ASSISTANT in the Civil Engineering Department at Paddington Station, experienced in design of prestressed and reinforced concrete bridges and other structures. Salary range £916–£956.

Travel concessions, holidays with pay, prospects of promotion and permanency, membership of Superannuation Fund.

Apply stating age, previous experience, &c., to Chief Civil Engineer, B.R. Western Region, Paddington Station, W.2. E8090

PUBLIC APPOINTMENTS

CIVIL/STRUCTURAL ENGINEERING

West Midlands Divisional Coal Board have a civil/structural engineering vacancy on their engineering staff at Divisional headquarters (near Dudley).

Preference will be given to Corporate Members of the Institution of Civil Engineers or Institution of Structural Engineers. Consideration will, however, be given to candidates engaged in systematic training for those qualifications or who have a wide experience in civil engineering drawing office practice, design work and a knowledge of bills of quantities and specifications.

Salary within the range £900–£1400.

Applications—on forms obtainable from Divisional Chief Staff Officer, West Midlands Divisional Coal Board, Himley Hall, Dudley, Worcs. (quoting EN), by August 8, 1958.

E8113

STRUCTURAL ENGINEERING DRAUGHTSMEN

required by

MINISTRY OF WORKS

for employment in London, Scotland and Provinces on design and detailing of reinforced concrete or structural steelwork.

SALARY RANGE £550 (age 21) to £870 p.a., London (slightly less elsewhere). 5-DAY WEEK. 3½ WEEKS' ANNUAL LEAVE INITIALLY.

STARTING PAY ACCORDING TO AGE, QUALIFICATIONS AND EXPERIENCE.

GOOD PROSPECTS OF PROMOTION WITH SALARIES OF £1015 p.a. AND ABOVE.

OPPORTUNITIES FOR PERMANENT POSTS LEADING TO PENSIONS (NON-CONTRIBUTORY).

Possession of O.N.C. or equivalent an advantage.
Interviews at Regional Offices where possible.

APPLICATIONS.—State age, training and experience to Chief Structural Engineer, Ministry of Works, Room 404, Abell House, John Islip Street, S.W.1.

E7717

A. E. R. E. HARWELL

has vacancies for qualified Engineers to assist in the running of

(a) A workshop, millwrighting, plant erection and maintenance.

(b) The Services Section (steam, water, gas, air; heating and ventilating).

Both posts involve investigations and preparation of schemes. Technical soundness and a theoretical bent are more important than wide practical experience; an Engineering Degree would be an advantage.

Salary: £815—£1270

Send a POST CARD to Group Recruitment Officer (1172/25), *A.E.R.E., Didcot, Berks, for application forms and details.*

PROTON SYNCHROTRON

a professionally qualified

MECHANICAL ENGINEER

with sound experience in the maintenance and operation of engineering plant and equipment is required, initially, to inspect, accept and commission mechanical plant for the 7 GeV Proton Synchrotron, and, later, to organise and control operation, maintenance and modification of that plant.

Salary: £1300—£1740

Send a POST CARD to Group Recruitment Officer (1168/25), *Atomic Energy Research Establishment, Didcot, Berks, for application form and details.*

REMOTE HANDLING

Two Professionally qualified Engineers are required to develop, in direct consultation with scientists and other engineers, remote handling devices and techniques to facilitate work on radioactive materials.

Experience in light/medium mechanical engineering development is required and an Engineering Degree would be an advantage. Experience with radioactive materials is not necessary.

Salary: between £815 and £1740 according to age, qualifications and experience.

Send a POST CARD to the Group Recruitment Officer (1171/25), *Atomic Energy Research Establishment, Didcot, Berks, for application forms and details.*

E8111

TENDERS

INDIA STORE DEPARTMENT

The Director, India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington, D.C., United States of America, invites TENDERS for the following:

Tender Enquiry No. SE/3 for the SUPPLY of HEAVY EARTH-MOVING MACHINERY and ORDINARY MINING MACHINERY required for use in Indian coal mines.

Specifications, drawings, &c., relative to the above can be purchased direct from "India Supply Mission" of the above address or from "India Store Department," Government Buildings, Bromyard Avenue, Acton, London, W.3, at 2 dollars or 14s. and 6d. per copy. Tenders are to be returned direct to "India Supply Mission," 2536, Massachusetts Avenue, N.W. Washington, D.C., United States of America, so as to reach there by 9.15 a.m. on 11th August, 1958.

Specimen copy of the above Specification can be seen at "India Store Department," Government Buildings, Bromyard Avenue, Acton, London, W.3, under reference S.3408/58/AVH/ENG.2. E8076

INDIA STORE DEPARTMENT

DAMODAR VALLEY CORPORATION

The Office of the Damodar Valley Corporation, Anderson House, Alipore, Calcutta 27, India, invites TENDERS for the following:

D.V.C. Tender Enquiry No. PE-SPEC. 52 for the SUPPLY of LUBRICATING OIL-TRANSFER PUMPS, LUBRICATING OIL DELIVERY PUMPS, OIL TRANSFER PUMPS and LIGHTING OIL PUMP.

Specifications, drawings, &c., relative to the above, can be purchased direct from "Damodar Valley Corporation" of the above address at 9 shillings per copy plus £1 17s. 6d. for air parcel charges. Tenders are to be returned direct to Damodar Valley Corporation, Anderson House, Alipore, Calcutta 27, India, to reach them by 3 p.m. on 13th August, 1958.

Specimen Copy of the above specification is on view at "India Store Department," Government Building, Bromyard Avenue, Acton, London, W.3, under reference S.3415/58/AVH/ENG.2. E8077

EDUCATIONAL

A.M.I.MECH.E., B.Sc., City and Guilds, etc. Guarantee Postal Courses for all Exams., and Technical Divisions from Elementary to Degree standard. Approximately 95 per cent. successes. 144-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 B

TECHNICAL HOME STUDY COURSES

For A.M.I.Mech.E., A.M.I.Chem.E., A.M.I.M.I., A.F.R.Ae.S., C. & G., &c.

OVER 50 FIRST PLACES and more than 2000 Passes have been secured by T.I.G.B. Students at Professional Engineering Examinations. We have a wide range of exclusive Home Study Courses in all branches of Engineering—Mechanical, Electrical, Aeronautical, Automobile, Chemical, Gas, Radio, and Television, Draughtsmanship, &c. Textbooks, blueprints, &c., are provided and, if desired, fees may be paid by moderate instalments.—Write (stating subject of interest) for copy of 110-page Prospectus FREE and without obligation.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN
(Dept. 76),
29, WRIGHT'S LANE, LONDON, W.8.
E102 B

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES, NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

APPLICATIONS ARE INVITED FROM ENGINEERS for responsible posts in the following fields:

Machining and Pressworking Processes.
Design and Development of Machine Tools.
Automation of Production and Inspection Processes (a knowledge of work study techniques would be advantageous).
Vibration and Servo-Mechanisms.

Excellent opportunities for those with ability and initiative. Candidates should have a degree, Higher National Certificate or equivalent qualification.—Send full details including age, qualifications, experience and present salary in confidence to BOX No. E8107, "The Engineer." A

APPLICATIONS ARE INVITED by W. H. A. Robertson and Co., Ltd., Lynton Works, Bedford, for the position of WORKS ENGINEER. Candidates must have held a responsible position in the works engineering department of a company engaged in the heavy engineering field, and should preferably be chartered mechanical engineers. The position carries responsibility for the maintenance of machinery and equipment in well-equipped and modern machine and fitting shops, and for the civil, mechanical and electrical work involved in extensions to the factory, which are in the course of erection. There is a good pension scheme and housing assistance will be given.—Applications in writing, giving full details of qualifications and experience, stating age and salary required, should be addressed to Personnel Department, W. H. A. ROBERTSON AND CO., Lynton Works, Bedford. E8132 A

BOOKS and PUBLICATIONS

A Short History of the Structural Fire Protection of Buildings

by S. B. HAMILTON

Traces the development of ideas on the protection of buildings against fire from early times to the present day. Illustrated. **5s.** (*post 5d.*)

Simplified Daylight Tables

Intended for use in the early design stages of a building, these tables have been computed to enable daylight factors to be determined without the need for scale drawings. **1s. 9d.** (*post 4d.*)

HMSO

from the Government Bookshops or through any bookseller

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TECHNICAL BOOKS
PARKER ST., KINGSWAY, LONDON, WC2

THE PRACTICAL ENGINEER POCKET BOOK
Edited by N. P. W. MOORE, B.Sc., A.C.G.I., etc. Here is the sixty-sixth edition of this ever popular pocket book. With over 700 pages, it provides the engineer with a wealth of ready and useful information which can be obtained almost at a glance. 12/6 net.

WORK MEASUREMENT AND INCENTIVES
By D. G. LINTERN, B.A., etc., and R. J. S. CURTIS, B.A., etc. Direct in approach and basic in its treatment of technicalities, this is the first book to provide a suitable introduction to the subject for students. 25/- net.

SOLUTION OF PROBLEMS IN STRUCTURES
By W. T. MARSHALL, B.Sc., Ph.D., M.I.C.E., etc. Here is the first book of its kind to use such a direct and practical approach to the subject. In it are over 350 worked and unworked examples (with answers) of the kind of problem that the degree student will meet in examinations. 27/6 net.

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By A. S. HALL. Nowadays, graphic methods of presenting data and information are of great importance and offer many advantages. This new book sets out those fundamental ideas on which to base the choice of the best graph for a particular purpose. It is of great interest to all engaged in the presentation and analysis of data. 25/- net.

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Book I: ELEMENTS OF INDUSTRIAL ORGANIZATION
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Two standard works which are completely up to date. Together they cover the I.Mech.E. syllabus in Industrial Administration.

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SITUATIONS VACANT

APPLICATIONS ARE INVITED for the following appointment at the CLAYDON, SUFFOLK, Works of THE BRITISH STEEL PILING CO., LTD.:—
SENIOR DESIGNER-DRAUGHTSMAN (minimum qualifications H.N.C. or equivalent).
Age group 28–35 years. Candidates should be capable of accepting responsibility for complete projects.
THIS APPOINTMENT IS PERMANENT AND PROGRESSIVE IN AN EXPANDING ORGANISATION, and the successful candidate will be engaged on interesting work in connection with special crane type structures, hoisting machinery (steam, diesel, electric) and contractors' plant.
Contributory pension scheme in operation. Good canteen facilities. Salary in accordance with qualifications and experience. Holiday arrangements respected. The works are situated 15 minutes' bus ride from the centre of Ipswich. Applications to The Personnel Officer at the above address. E8012 A

APPRENTICE SUPERVISOR required for recently established Apprentice School at Fort Dunlop. Candidates should have practical engineering experience, preferably based on an apprenticeship, and technical education to National Certificate level. They should be capable of organising the training of Apprentices, giving them practical instruction and supervising such instruction by craftsmen instructors, and of guiding them in support of their studies at Technical College. Candidates should be between 35 and 50, experience in a similar post, Service or civilian, being desirable.—Please write, giving age, education, experience and salary required, to Personnel Manager, Dunlop Rubber Co., Ltd., Fort Dunlop, Erdington, Birmingham, 24. E8137 A

ASSISTANT CHIEF ENGINEER wanted for process plant. H.N.C. Mechanical Engineering. Age about 30 years. Experience air conditioning, plant layout, planned maintenance an advantage. Salary £850–£900, according to experience.—BOX No. E2014, "The Engineer." A

ASSISTANT TO MANAGER OF POWER DEPT. of important Electrical Manufacturers in London Area. Applicants should preferably be Member of the I.E.E., possess a University Degree and have served an apprenticeship with an Engineering firm. General experience of Heavy Electrical Plant and some commercial knowledge would also be an asset. The position offers prospects to a young man under thirty.—Write, giving personal details, qualifications, experience, age and present remuneration and position to BOX No. E8109, "The Engineer." A

BROWN AND POLSON, LIMITED,
largest manufacturers of Maize starch and its derivatives in Britain and part of an international organisation in this field require in this expanding industry
GRADUATES
in Mechanical or Chemical Engineering or Applied Chemistry and other young men with minimum H.N.C. qualifications.
Age up to 32.
Industrial experience and educational and personal details must be given in applications.
The Company's Salary scales are good, and modern employee benefits and a Profit Payment Plan are in operation.
Write to: Group Personnel Manager, Brown and Polson, Limited, 125/130, Strand, London, W.C.2.

E8112 A

CHEMICAL ENGINEER
required by the Chemicals Division of The British Oxygen Company, Ltd., for interesting position. Experience in large scale production, preferably in the heavy organic field, with some background of costing and development work. Headquarters in London.
Age range 30–35. Progressive and pensionable position. Assistance with housing, if necessary.
Write, giving full details of age, experience, &c. to Personnel Manager, Dept. C.E., British Oxygen Company, Ltd., Bridgewater House, Cleveland Row, St. James's, London, S.W.1.

E8086 A

COLGATE-PALMOLIVE LIMITED
Manchester
invite applications from
DESIGNER DRAUGHTSMEN
with experience of chemical plant layout and design. Knowledge of service pipe-work arrangements an advantage and H.N.C. called for. Salary and conditions of employment are good in a modern factory with excellent accommodation and amenities.—Applications, giving details of age, salary expected, training, qualifications and experience, should be sent to Factory Personnel Manager, 371, Ordsall Lane, Salford, 5.

E8088 A

CONTRACTS MANAGER required for railway and civil engineering firm. Applicants must be qualified civil engineers experienced in railway design and construction, well versed in contract procedure and capable of meeting and dealing with the project engineers of the nationalised industries and with consultants. The position is an executive one and involves controlling contracts and site personnel in various parts of the country. Initiative and drive are essential, and the appointment offers excellent scope, good salary and incentive bonus to the successful applicant. Applications, which will be treated in the strictest confidence, should state age, qualifications, experience in detail, and indication of salary required.—Write, General Manager, Eagre Construction Co., Limited, East Common Lane, Scunthorpe telephone No.: Scunthorpe 4513). E8073 A

SITUATIONS VACANT

DESIGN ENGINEER capable of producing practical ideas giving guidance to draughtsmen and being responsible for finished drawings and specifications, required by large modern firm producing Pressure parts for varying services and temperatures. A knowledge of combustion and light foundry work an advantage. Drive, initiative and good technical qualifications essential. Excellent prospects for right man.—State age, experience and present salary.—BOX No. E7953, "The Engineer." A

DESIGNER DRAUGHTSMAN (MECHANICAL) required for Research and Development Team engaged on interesting development work in connection with special structures and diesel and steam operated plant. Minimum qualifications, O.N.C. Age group 24–30 years. The appointment is permanent and progressive in an expanding organisation. Contributory Pension Scheme and good canteen facilities. Salary in accordance with age, qualifications and experience. The works are situated 15 (fifteen) minutes 'bus journey from the centre of Ipswich.—Applications to Personnel Officer, THE BRITISH STEEL PILING CO., LTD., CLAYDON, SUFFOLK. E7950 A

DESIGNER DRAUGHTSMAN required by Dunlop Rubber Company in their Development Division for work on prototype machines for a wide range of development projects. Excellent prospects to a man capable of following interesting projects through to production stage with a minimum of supervision. Preferred age range and qualifications 20–30 with H.N.C. (Mech. Eng.) or equivalent experience. Five-day week, pension scheme, and very good working conditions.—Please reply, in confidence, to Personnel Manager, Dunlop Rubber Company, Ltd., Fort Dunlop, Erdington, Birmingham, 24, quoting reference J.M.152. E8091 A

DRAUGHTSMAN, experienced, quick and accurate for layout Chemical and General Engineering, London. Excellent conditions and salary.—BOX No. E8095, "The Engineer." A

DRAUGHTSMAN, SENIOR, to take charge small London office. Capable man with organising ability. Mechanical and Chemical Plant.—BOX No. E8097, "The Engineer." A

ELECTRICAL DRAUGHTSMAN.—The Stanton Ironworks Company, Limited, Near Nottingham, has a vacancy for an Electrical Draughtsman with experience in planning schemes for lighting and power distribution and preparation of wiring diagrams for motors, control gear, &c., as applied to heavy industrial practice. The post is pensionable; 5-day week. Holiday arrangements honoured.—Write in confidence to the Staffing Officer, stating age, qualifications and experience. E8135 A

ELECTRIC ARC MELTING SHOP SHIFT MANAGER for large steelworks in the Midlands. Applicants, aged 30–40, should have a metallurgical training with practical experience in an Electric Melting Shop. Salary according to qualifications and experience. Pension and free life assurance scheme in operation. Full details of age, experience and qualifications to BOX No. E7975, "The Engineer." A

ENGINEER/DRAUGHTSMAN for occasional commissioning small industrial plants and also work in Drawing Office on layout and general machine design. Must be experienced. Good presence and address.—BOX No. E8096, "The Engineer." A

ENGINEERING CONSULTANTS require for their London Office a professionally qualified CHEMICAL DESIGN ENGINEER to take control of Chemical and associated plant Department. Duties entail project development and design layouts and also supervision of site duties. This is a senior executive appointment and candidates are invited to forward applications outlining history of experience and qualifications and positions held to date together with details of corresponding scales of emoluments for each appointment.—BOX No. E7935, "The Engineer."

FIRST CLASS DESIGN DRAUGHTSMAN, with sound mechanical engineering background, required for London Engineers manufacturing machinery for tobacco and other industries. Please state when free and salary expected.—Reply BOX No. E2013, "The Engineer." A

HEATING INTERMEDIATE DRAUGHTSMAN required in London accustomed to design with minimum supervision. Salary up to £1000 per annum to right man. Permanent position with pension facilities and excellent prospects.—Write in confidence, stating full details of age, experience and past employers to Ellis (Kensington), Ltd., Kendrick Place, London, S.W.7. E2001 A

LEADING INSURANCE COMPANY invites applications from Mechanical Engineers not over 35 years of age for appointment as ENGINEER SURVEYOR in London and surrounding districts. Applicants should have served an apprenticeship and had subsequent experience with a General Mechanical Engineering Company or Companies and should be Corporate Members of the Institution of Mechanical Engineers. Progressive salary scale commencing at £735 rising to £1060 over 22 years, plus expenses and allowances. Non-contributory Pension Scheme and other Staff Schemes. Apply in own handwriting.—BOX No. E8602, "The Engineer." A

LIGHT ENGINEERING FIRM near Nottingham require CHIEF TOOL DESIGNER, who has previous experience in connection with press work fabricating metal products, and is familiar with machine shop practice. Please reply, giving full particulars of age, education and experience.—BOX No. E1991, "The Engineer." A

MAINTENANCE ENGINEER. Preferable with building experience for medium size company West London. Wood and Allied Trades. Applicants interested in hard work and achievement rewarded—others need not apply. Salary according to ability, experience and personality. Minimum £620 p.a. Practical journeyman and sound supervisor required. Incentives/Bonus.—BOX No. E1983, "The Engineer." A

MECHANICAL INSPECTOR of first class experience, preferably with electrical knowledge, although not essential, for Scientific Instrument manufacturers. Staff appointment. Good salary. Pension Scheme. 5-day week.—Apply: Works Manager, Baird and Tatlock (London), Ltd., Blackhorse Lane, Walthamstow, E.17. Phone: Larkswood 2603. E8122 A

Classified Advts. continued on page 110

SITUATIONS VACANT

MACHINE SHOP PLANNING ENGINEER required by a diesel engine manufacturing company. The successful applicant will be concerned with batch and flow production of engineering components. He must have experience of high production methods and knowledge of material, tool and labour costs an advantage. Excellent conditions of service and good salary will be offered to the applicant possessing the right qualification.—Please apply in writing, giving full details of experience and salary required, to Chief Personnel Officer, PETTERS, LIMITED, Causeway Works, Staines, Middx. E8131 A

PHILBLACK LIMITED require a DEVELOPMENT ENGINEER for their Carbon Black Works at Avonmouth. Applicants should hold a B.Sc. degree and the equivalent of a professional qualification. Whilst experience of the carbon black industry is not expected, experience of Chemical or Petroleum plants, Electrical Installations or Instrumentation will be an advantage. The position will appeal to an able and alert man who is able to work on his own initiative and who is interested in going ahead with a young and growing Company. The starting salary will not be less than £1100. Contributory pension scheme.—Apply to the Works Engineer, Philblack, Limited, Avonmouth Docks Estate, Avonmouth, Bristol, stating experience, qualifications and age. E8098 A

PRODUCTION ENGINEER required by progressive light engineering company near Nottingham. This is a senior post offering considerable scope for capable man. He will be entirely responsible for all manufacturing methods, and have charge of technical staff. The company's plant includes press shop, machine shop, including automatics, and well-equipped toolroom. A good salary will be paid, commensurate with the responsibilities involved. Please reply in confidence, giving full particulars of age, education and experience.—BOX No. E1990, "The Engineer." A

SENIOR DRAUGHTSMAN WITH EXPERIENCE IN ELECTRICAL ENGINEERING

An old-established Firm of Engineers with large overseas market, and located in North-west England, requires a SENIOR DRAUGHTSMAN with Electrical Engineering background. The product is frequently tailor-made and is of the heavy machine tool type. Applicants must be well versed in modern methods of electrical control and be capable of working on own initiative. The position offered is one on our permanent staff and is pensionable. The commencing salary will be in the range £800 to £900 per annum.—Please reply to BOX No. E2012, "The Engineer." A

SHELL-MEX AND B.P., LTD., have vacancies in their London Office for qualified ENGINEERS. Candidates should have had thorough training in workshops and possess either Corporate Membership of the Institutions of Civil or Mechanical Engineers or have passed parts A and B of one of these Institutions' examinations (or have qualifications entitling them to exemption from such examinations). Experience on pumps and pipelines or building construction will be advantageous. Starting salary commensurate with qualifications and experience. Excellent pension scheme.—Apply in writing giving full details of age, qualifications and experience to the Staff Manager, (Ref. 29/132) Shell-Mex and B.P., Ltd., Shell-Mex House, Strand, W.C.2. Second applications cannot be considered. E7983 A

TECHNICAL INFORMATION ASSISTANT. Lady over 25, British-born. Must have technical background, preferably H.N.C. including physics as subjects cover Electrical and Mechanical Engineering. Knowledge of U.D.C. and typing desirable. 5-day week. Outer London (Essex).—Please reply, giving full details to BOX No. E8101, "The Engineer." A

TECHNICAL SALES ENGINEERS required, preferably with hydraulic and combustion experience. Sound technical background to Higher National Certificate standard. Successful applicants would be based in Birmingham and must be free to travel.—Apply in writing, giving full details of experience, to Personnel Manager, Joseph Lucas (Hydraulic and Combustion), Ltd., Shaftmoor Lane, Hall Green, Birmingham, 28. E8079 A

TECHNICAL WRITER wanted, to assist in the preparation of technical descriptions and instruction books. Good education and engineering training with experience of turbine-driven plant, both in operation and maintenance, essential. Salary in accordance with qualifications and experience.—Apply to Personnel Manager (HAD), THE GENERAL ELECTRIC COMPANY, LIMITED, Erith, Kent. E8136 A

WELTON ROSSER, LIMITED,

have interesting vacancies on several projects in the U.S.A. and Canada for which they have been retained as consultants.

PHYSICISTS
MECHANICAL ENGINEERS
ELECTRICAL ENGINEERS
ELECTRONIC ENGINEERS

with advanced design experience are invited to write for application form to :

WELTON ROSSER, LTD.,
12, Duke Street, St. James's, London, S.W.1.

E2008 A

THE MAKERS OF HOLLANDS TOFFEE require a DRAUGHTSMAN (Mechanical), age 25–32. Qualifications must include apprenticeship and at least H.N.C. Workshop experience desirable, coupled with knowledge of machine design and mechanical handling. Experience of confectionery machinery manufacture an advantage. It is anticipated that successful candidate will ultimately assume responsibility for design and development work. Salary according to qualifications and experience. Non-contributory Pension Scheme.—Full details in own handwriting to Personnel Manager, Arthur Holland, Virginia Street, Southport, Lancs. E8089

SITUATIONS VACANT

SITE ENGINEER

required to supervise the construction of welded oil storage tanks. Position incorporates non-contributory pension scheme.—Write, stating age, qualifications and previous experience, to BOX No. E8121, "The Engineer."

A

SMITHS OF ENGLAND
(MOTOR ACCESSORY DIVISION)

An ASSISTANT QUALITY CONTROL ENGINEER is urgently wanted in our N.W. London Engineering Department. Interested men would be required to study machine and process capabilities, set up and analyse progress reports and initiate corrective action.

The work field flows from Goods Inwards, through machinery section to belt assembly in a newly established Quality Control department.

Excellent working conditions and opportunities for advancement make employment with this Company an attractive proposition.

If you are interested you should write, stating your age, experience and salary required, to the :

Staff Manager,
S. Smith and Sons (England), Ltd.,
Cricklewood Works, London, N.W.2,
quoting reference SW/122.

E8126 A

BRITISH OXYGEN GASES LIMITED
(EQUIPMENT DIVISION)

DESIGN ENGINEER

Applications are invited for the post of Design Engineer, tenable at the Company's Design Offices at Harlow, in Essex.

Applicants should possess a Degree in Mechanical Engineering or equivalent qualifications, and must have had some years' general mechanical design experience in the field of light to medium engineering.

The Company is pursuing an intensive programme directed to the development of novel equipment for use in the shipbuilding and fabrication industries. Typical problems to be encountered will involve structural design as conditioned by servo control requirements, and the design of gear drives and associated mechanisms.

While the successful applicant will not be expected to possess a detailed knowledge of servo theory he must have a clear appreciation of the design approach necessary to ensure the satisfactory combination of such control systems with other machine elements. Excellent salary and conditions of service are offered and assistance with housing may also be given.

Applications, in writing, giving full details, should be sent to :

The Employment Officer (E/C 1127),
BRITISH OXYGEN GASES LIMITED,
Equipment Division,
Angel Road, Edmonton N.18.

E8085 A

SITUATIONS VACANT

MSL have been retained to advise on the appointment of the

CHIEF ENGINEER

to a private company within a service industry, with three works situated in a town on the South Coast.

The Chief Engineer will be responsible for all maintenance including the operation of three oil-fired automatic boilers of up to 12,000 lbs. per hour capacity. He should have a degree or equivalent qualification in mechanical engineering and have had experience of the administration of plant engineering in a process industry. Because of increasing use of electronic control, additional qualification or experience in that field would be an advantage.

Initial salary about £1,500 plus car.

No information will be disclosed to our clients until candidates know their identity and have given permission after personal discussion. Please send brief details in confidence, quoting reference G.1093, to G. K. Dickinson.

MANAGEMENT SELECTION
LIMITED
17, Stratton Street, London, W.1.

E8104 A

MSL have been retained to advise on the appointment of a

CHIEF ENGINEER

for a company in London manufacturing fine chemicals for the pharmaceutical industry. He will join a young and enthusiastic management team working in a modern single storied factory, at present being extended.

The Chief Engineer will be responsible for maintenance of all services, installation and layout of plant and equipment and supervision of new building projects.

A professional qualification or degree in mechanical or chemical engineering, together with experience of plant maintenance in a process industry, preferably chemical manufacturing, is essential.

Commencing salary about £1750 with superannuation and life insurance benefits.

Preferred age 30–38.

No information will be disclosed to our clients until candidates know their identity and have given permission after personal discussion. Please send brief details in confidence, quoting reference G.1134, to W. F. Younger.

MANAGEMENT SELECTION
LIMITED
17, Stratton Street, London, W.1.

E134 A

ENGINEERING MANAGEMENT

DESIGN SPECIALISTS

An expanding, internationally known organisation invites applications for engineering *MANAGEMENT POSITIONS*, which are available in view of the company's programme for progressive development. Applicants should have a first-class administrative record with sound supervisory experience, combined with outstanding technical qualifications.

CHIEF DESIGNER

The successful candidate will be in charge of a well-established Design Department in the development and extension of the present range of high-speed turbines. Age range 35–45. A good Engineering Degree or similar qualifications with A.M.I.Mech.E. essential. Extensive experience in industry is required with particular application to all aspects of turbine development. Excellent four-figure salary. Good prospects.

DESIGNER (STEAM TURBINES)

Successful applicant will control design functions with responsibility for the development and extension of present manufacturing commitments, integrated with other designs. Age range 28–35. Engineering Degree or equivalent preferable, with A.M.I.Mech.E. essential. Several years' industrial experience covering all aspects of turbine design a prerequisite. Substantial salary, depending upon experience and qualifications.

Both positions covered by generous non-contributory pension plan.

Apply, in GUARANTEED STRICTEST CONFIDENCE, stating date and place of birth, details of education, names of firms, and positions held, starting and final salaries, with dates, and quoting reference E.A.3155, for CHIEF DESIGNER, and E.A.3156 for DESIGNER (STEAM TURBINES). A contact telephone number would expedite acknowledgments.

Dr. P. S. de Q. Cabot,
P. S. CABOT AND COMPANY,
37–41, BEDFORD ROW LONDON, W.C.1.

E8105 A

SITUATIONS VACANT

THE ENGLISH ELECTRIC CO., LTD.,
RUGBY,

have vacancies in their Development Department for experienced

DRAUGHTSMEN

capable of preparing test berth layouts. These are concerned with developments taking place on steam and water turbines, and diesel engines, and considerable opportunity exists for draughtsmen who like varied work. Applicants should preferably be of H.N.C. standard, and have at least three years' industrial drawing-office experience.—Write, giving full details, to Dept. C.P.S., 336/7, Strand, W.C.2, quoting Ref. E 1199L.

E8115 A

A SENIOR STANDARDS ENGINEER

is required with a knowledge of valves, pipework and general chemical plant and of B.S. and A.S.M.E. specifications.

It is desirable that applicants should have had previous experience in a Standards Department but this is not essential, provided there is previous practical and design experience on chemical or petroleum plant. Membership of a professional institution is desirable.

The appointment carries a good commencing salary and excellent conditions of service.

Assistance may be given with removal and legal expenses, if it should be necessary for the successful applicant to move his home.

Applications, giving full details of age, qualifications, experience and present salary to :

The Personnel Manager (GH/18)
BRITISH OXYGEN ENGINEERING, LTD.,
Angel Road, Edmonton, London, N.18

E8084 A

SENIOR DEVELOPMENT ENGINEER

to take charge of a Development Laboratory operating in conjunction with a Division manufacturing a very wide range of accessories for the electric supply industry. Candidates should be capable of directing laboratory staffs in all aspects of the development of new products, which entails pronounced powers of leadership, combined with original thought and technical ability.

Applications are accordingly invited from Engineers with a University Degree and several years' experience in the Engineering Industry, preferably in this type of work.

An attractive salary will be offered ; conditions of employment are excellent and there is good scope for further advancement.

Apply, Box No. E8066 "The Engineer."

WORKS MANAGER

A progressive, expanding manufacturing organisation in South Yorkshire wishes to appoint a Works Manager for its well-equipped plant, which employs 800 personnel. Candidates should have considerable experience of factory management in the field of precision turning, grinding and assembly. This appointment carries a very attractive salary, together with excellent conditions of service, and the successful candidate will be a member of the top management team, and responsible to the General Manager.—Please reply, giving full details of age, present salary, experience and qualifications, which will be treated in the strictest confidence, to the General Manager, BOX No. E8080, "The Engineer."

A

SITUATIONS WANTED

ENGINEER (33), A.M.I.Mech.E., design, development and tool experience in engines, auto. and aero, electronics, welding, aluminium processing, plant and services, seeks position of responsibility.—BOX No. E2010, "The Engineer." B

SENIOR MECHANICAL DESIGN DRAUGHTSMAN, 16 years' D.O. workshop experience, requires situation in London or South.—Oakes, 12, The Mount, Coulsdon, Surrey. E2011 B

FOR HIRE

LATTICE STEEL Erection Masts (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1 ('Phone, SLOane 5259). E103 K

HIRE A £1500 CAMERA FOR ONLY £5. All other types of photographic equipment available.—B. Bennett and Sons, Ltd., 25/27, Oxford Street, London, W.1 (Telephone, GERard 9953). Catalogue on request. E128 K

DRAWING & DESIGN SERVICE

COMPETITIVE STEELWORK DESIGNS, plans and detail drawings for all kinds of buildings and structures by experienced Structural Engineers. Quick service. HOLborn 2587. E1964 S

SUB-CONTRACTING

ACCURATE MACHINING
also on Models and Prototypes, &c.
MILLING TURNING
JIG BORING PLANING
PRESS TOOLS, JIGS AND FIXTURES
HORIZONTAL BORING
GIVE US YOUR DIFFICULT JOBS
LANDEN (ENGINEERS), LTD.
1A, AUBERT PARK, LONDON, N.5.
CANonbury 1075 E115 MW

CASTINGS.—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process ; sample castings treated ; A.I.D. approved. —Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex ('Phone, Byron 1178). E109 MW

KELLERING AND CAM PROFILING capacity up to 8ft. by 6ft. or 6ft. diameter.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Telephone : Knottingley 2743/4). E116 MW

METAL FABRICATIONS, ¼in. thickness, Spot Welding, Profile Cutting. A.I.D. approved. Specialists in quick delivery.—Bankfield Engineering Co., Ltd., Southport (87427). E1989 MW

PRECISION ENGINEERS.—Personal service for prototypes, small quantity machined parts and equipments. Design and development undertaken. A.I.D. Approved.—Bowyer, Smyth and Partners, Ltd., Vineyard Walk, Clerkenwell, E.C.1 ('Phone, TERminus 5113/4). E112 MW

MACHINERY Etc. WANTED

WANTED, Machines of all Types.
CASH PAID.
Norman E. Potts (B'ham), Ltd., 130, Moseley Road, Birmingham, 12. VIC. 1278, 1279, 1270, 0856. E104 F

NORMALISING FURNACE for Steel Sheets, 9ft. by 4ft. by 0·3 to 4·0m.m. thick, 950 C., 2 tons per hour, gas and oil heated.—BOX No. E8119, "The Engineer." F

LANCASHIRE BOILER, must be 9ft. dia. 150 p.s.i., would prefer 180 p.s.i. Make not older than 1945.—BOX No. E8110, "The Engineer." F

FOR SALE

PORT OF BRISTOL AUTHORITY

ENGINEER'S DEPARTMENT

STEAM LOCOMOTIVES

The Port of Bristol Authority has for disposal TWO 0-6-0 SADDLE TANK STEAM LOCOMOTIVES, built by Messrs. Peckett and Sons, Bristol, the general particulars being :

1. Loco. "Kenneth," gauge 4ft. 8½in.
   Tractive effort 10,200 lb.
   Weight in working order 28 tons.
   Year of construction 1900.
   New boiler fitted with firebox 1938, new brass tubes fitted 1951.
2. Loco. "Alfred," gauge 4ft. 8½in.
   Tractive effort 12,860 lb.
   Weight in working order 30 tons.
   Year of construction 1914.
   New boiler fitted with firebox October, 1939, new brass tubes fitted 1952.

The locomotives can be inspected, by arrangement, at Avonmouth Docks.

Applications for forms of Tender to be made to the Engineer-in-Chief, Port of Bristol Authority, Avonmouth Docks, not later than 15th August, 1958. E8129

"FIELDING"
SINGLE COMPRESSION
SCRAP METAL BALING PRESS

Size of box—72in. by 36in. by 32in. deep.
Depth of box when cover closed—18in.
Size of bale—36in. by 18in. by 10in. to 12in.
Weight of bale approximately 3 to 4 cwts.
Estimated output 20/22 bales per hour.
Preliminary pressing power, cover ram—208 tons
Specific pressure on material—5 tons per sq. ft.
Power of horizontal ram—208 tons.
Specific pressure on material—46 tons per sq. ft.
Stroke of horizontal ram—73in.
Pressure medium—Oil.

PUMP
Motor-driven high-speed oil pump capable of delivering :
40 g.p.m. at 1500 lbs. per sq. inch.
17 g.p.m. at 2 tons per sq. inch.

MOTOR
50 h.p., 720 r.p.m. T.E.S.C. complete with 50 h.p. wall fixing starter, H.O. Oil immersed Star Delta.
Date of Installation—August, 1955.
Apply.—BOX No. E8013, "The Engineer." G

FIVE new 10,000 Barrel capacity bolted steel Bulk Storage Tanks, by Columbian Steel Tank Co., 55ft. dia. by 24ft. high, packed in original cases.
REED BROTHERS (ENGINEERING), LTD.,
Replant Works,
Woolwich Industrial Estate,
London, S.E.18.
Telephone : Woolwich 7611/6. E8118 G

FOR SALE

FRED WATKINS
(ENGINEERING), LTD.

STEAM BOILERS.—Cochran Vertical (New) 8ft. 6in., 8ft., 7ft. 6in., 7ft. and 6ft. in dia. 100/150 lb. w.p. ; reconditioned 8ft. 6in. down to 3ft. dia. ; Economic 4ft. to 11ft. 6in. dia., including new 7ft. and 8ft. dia., 150, 180 and 200 lb. w.p. ; 300 reconditioned Vertical Crosstube, all sizes.

AIR COMPRESSORS.—Broomwade 400, 300, 200 and 130 cu. ft. ; all motorised ; Roavell Rotary Blowers, 2000 c.f.m., 3–2 p.s.i.

200 **AIR RECEIVERS,** stocked up to 9ft. dia., 100 to 500 lb. pressure.

ELECTRIC MOTORS.—150 Totally Enclosed and Flameproof Motors up to 100 h.p.

CRANES.—Mobile 10-ton Lorain, lorry mounted, 30ft.–70ft. extendable jib ; 4-ton Coles Diesel-Electric ; 3-ton Jones Super 40 (3) ; Neals 2-ton Diesel, 20ft. jibs (2) ; Derrick, 5-ton Butters Electric travelling type, 90ft. jib ; 5-ton Wilson Electric 70ft. jib ; 3-ton Rushworth Electric, 65ft. jib ; Steam Loco, 18-ton Brownhoist, 50ft. jib ; 10-ton Coles, 40ft. jib ; 8-ton Wilson, 35ft. jib ; 5-ton Smith, 50ft. jib ; 5-ton Cowans Sheldon, 50ft. jib ; 5-ton Grafton, 38ft. jib ; E.O.T., 40-ton Adamson, 42ft. span ; 20-ton Vaughan, 42ft. span (8) ; Goliath, 40ft. span, 60-ton Clyde, 40-ton Babcock, 10-ton Morris ; 5-ton Henderson, 24ft. 7½in. span, 1946 ; 5-ton King, 29ft. 3in. span ; 2-ton Morris, 18ft. span, 2-ton Smith, 34ft. span.

RAILWAY MATERIAL.—Hunslet 0-6-0, 18in. by 26in. cyl. ; Bagnall 0-4-0, 14in. by 22in. ; 150 h.p. Stephenson Diesel Loco., fluid flywheel drive ; Ruston 80/88 h.p. Diesel Loco., electric start, flameproof ; Peckett 14in. by 22in. and 7in. by 12in. Steam Locos. ; 3 miles 20 lb. Track, 24in. gauge bogies, turnouts, locos, &c.

STEEL PIPING.—50,000ft., 2in. Galvanised, new ; 60,000ft., 3in. black new ; 5000ft. 8in. seamless ; 1000ft. 12in. seamless ; 500ft., 14in. seamless ; 400ft., 18in. riveted ; 280ft., 21in. o.d. welded flanged ; 3800ft., 21in. seamless flanged ; 500ft., 24in. riveted ; 1450ft., 27in. o.d. welded flanged ; 216ft., 48in. riveted ; 216ft., 60in. riveted.

CAST IRON PIPES.—Large stocks all sizes up to 24in. flanged and s.s. Immediate delivery.

VALVES.—Exceptional Surplus Ministry Lot New Stainless Acid Cocks and Valves, over 5000, immediate delivery, below makers' prices. Large stock, all sizes, Parallel Slide Sluice, Gunmetal, Reducing and Check Valves. List on request.

STORAGE TANKS.—300 cylindrical and rectangular up to 12,000 gallons, for oil and petrol, also sectional steel and cast iron up to 50,000 gallons.

MACHINE TOOLS.—Scriven Plate Bending Rolls, 14ft. by ¾in. ; Robertson Straightening Rolls, 8ft. 6in. by ¾in. ; Berry Bending Rolls, 7ft. by ½in. ; Tangye 200-ton Hydraulic Vertical Straightening Press, 15ft. by 3ft. table ; Herbert 3ND Miller, 61in. by 15in. table ; Pels Punch and Shears, ¾in. capacity ; nine new 2 cwt. and 1 cwt. Pneumatic Hammers.

SLING ENGINEERING WORKS,
COLEFORD, GLOS.
'Phone : Coleford 2271/2. E106 G

600

ROLLING MILL DRIVES

FOUR 400 h.p. ROLLING MILL SLIPRING MOTORS by the English Electric Company, wound for 415 volts, 3-phase, 50 cycles, 738 r.p.m., coupled to gearbox by Power Plant Co., final speed 30 r.p.m. High-speed shaft with two flywheels—total kinetic energy 10,000 h.p. seconds, 30 h.p. barring motor and automatic Igranic control gear with slip-resistance.

750 h.p. ROLLING MILL MOTOR by Brown Boveri, date 1954 ; 2200 volts, 3-phase, 50 cycles, 146 r.p.m.

GEORGE COHEN,
SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
Tel. : Shepherds Bush 2070 and
STANNINGLEY, NR. LEEDS.
Tel. : Pudsey 2241. E202 G

TWW

TWO BRADLEY and TURTON FOUR-COLUMN DOWNSTROKE HYDRAULIC PRESSES, capacity 350 tons at 2 tons per sq. in. working pressure, fescolised ram 15½in. dia., stroke 24in., daylight 37in., platens 37in. × 40½in., 4in. dia. push-back rams, 1½in. dia. ejector rams, Prefill tank mounted on top of crosshead, and intensifier, input 1500 lb. per sq. in.

ONE FAWCETT PRESTON FOUR-COLUMN DOWNSTROKE HYDRAULIC PRESS, 200 tons capacity at a working pressure of 1500 lb. per sq. in., fescolised main ram 20in. dia., stroke 24in., daylight 40in., platens 28in. front to back × 26in. left to right, distance between columns 26½in., push-back rams, ejector ram and prefilling tank.

ONE BRADLEY and TURTON DOWNSTROKE FOUR-COLUMN HYDRAULIC PRESS, 150 tons capacity at 1500 lb. per sq. in. working pressure, dia. of ram 17in., stroke 18in., daylight 29½in., platens 30in. × 28in., distance between columns 36in., fully guided top platen, push-back rams, ejector and prefilling tank.

ONE SHAW FOUR-COLUMN UPSTROKE HYDRAULIC PLUNGER PRESS, fescolised ram 19in. dia. at 1500 lb. per sq. in. working pressure, stroke 17in., daylight 40in., platen size 30in. × 28in., distance between columns 36in.; the crosshead houses an 8in. dia. cylinder and ram, stroke of ram 15in., pull-back rams and prefilling tank.

THOS. W. WARD LTD.
ALBION WORKS - - - SHEFFIELD.
'Phone : 26311. 'Grams : "Forward."
E216 G

Classified Advts. continued on page 112

FOR SALE

VALES PLANT REGISTER LIMITED
OFFER FOR IMMEDIATE SALE

One Neale NM 2-ton Diesel Mobile Crane, Ruston engine. New 1950. On crawlers ; 25ft. jib. In good condition. £750.
One Jones " Super 40 " 3-ton Mobile Crane, 24ft. jib, on pneumatics, Ruston engine. Good condition. £925.
One Jones KL44 4-ton Mobile Crane, with 24ft. jib, Ruston diesel engine, on pneumatics. New 1953. Overhauled. £2200.
One Neale QM 4/6-ton Diesel Mobile Crane, with 45ft. jib, on pneumatics, Ruston engine. New 1953. In good condition.
One Coles 6-ton " Argus " Diesel-Electric Self-propelled Mobile Crane, with 40ft. jib, on pneumatics. New 1956. In good condition.
One 5-ton Morgan Electric Derrick Crane, single-motor type, 100ft. jib, BESA machine. In good condition. £2200.
One 5-ton Grafton Diesel Rail Crane. New 1942. Perkins P6 engine, 38ft. jib, 4ft. 8½in. gauge. Reconditioned.
One 7-ton Anderson Grice 2-motor type Electric Derrick Crane, 120ft. jib. New 1951. With cabin. In very good condition.
One 7-ton Butters Steam Derrick Crane, 100ft. jib, double-drum type. Unused.
One 10-ton Henderson Steam Derrick Crane, 120ft. jib. First used 1954. In very good condition.
One 10-ton Coles Diesel Rail Crane. New 1943. Perkins P6 engine, 40ft. jib, 4ft. 8½in. gauge. Reconditioned.
One 12½-ton Coles Petrol/Electric Fully Mobile Crane, with 45/80ft. jib. New 1950. Reconditioned recently. £5500.
Further details, 14, Lower Grosvenor Place, London, S.W.1. Telephone : VICtoria 7331, 3501, 8080, 9806 (15 lines). E107 G

TURNING MACHINES

FARMER NORTON 4in. Centreless Bar Turning Machines. Suitable for 1in.–4in. bars, with various cutter heads and other equipment. M.D.400/3/50.

H. BELL (MACHINE TOOLS), LTD.,
Walter Street, Leeds, 4.
Tel. : 63-7398 E105 G

FOR SALE, Butters 3-ton Electric Loco. Crane for 7ft. track, Wylie indicator, 35ft. jib. In good order, lying Watford.—Marples, Ridgway and Partners, Ltd., Metropolitan Station Approach Road, Watford, Herts. E7978 G

SCRIVENER No. 1 D.A. Centreless GRINDING MACHINE with Micrometer stop for Grinding, graduated in hundredths of a thousand inch. About five years old and in reasonably good condition. Best offers.—Chance Brothers, Ltd., Glass Works, Smethwick 40, Birmingham (Mr. G. Harris). E8102 G

FOR SALE

LOCOMOTIVES FOR SALE AND HIRE

14×22 040 BARCLAY
A selection in stock.
17×24 040 BAGNALL
A selection in stock.
18×26 060 BAGNALL
Insurance reports available.

R. S. HAYES, LTD.,
BRIDGEND, GLAMORGAN.
'PHONE : 1311/2/3.
E119 G

FOR SALE

600 h.p. totally enclosed Oil Cooled Helica REDUCTION GEAR, by Turbine Gears, Ltd., new 1942 ; ratio 730/38·7 r.p.m., as new.
Large STEEL-FRAMED BUILDING, 440ft. long by 60ft. span by 16ft. high to eaves ; complete with Asbestos Roof Sheeting.

F. BURRILL AND CO.,
235a, Cathedral Road, Cardiff.
Tel. : 26100.
E7985 G

METROPOLITAN-VICKERS 500 H.P. SLIP-RING ELECTRIC MOTOR, 196 r.p.m., 400/440/3/50 cycles, complete with control panel and reduction gearbox, giving a final speed of 8·1 r.p.m.
Motor and gearbox available separately if required.

JOHN CASHMORE, LTD,
Newport, Mon.
Tel.: Newport 66941 (6 lines).
E120 G

FOR SALE, 135 h.p. Slip Ring Motor, by L.D.C., 976 revs., 2000/2200 volts, 3-phase, 50 cycles, enclosed ventilated, ball bearings with liquid starter, by Erskine Heap.
Two 350 h.p. S.C. A.C. Motor, by Metro-Vick, 980 revs., 6300 volts, 3-phase, 50 cycles.
THOMAS MITCHELL AND SONS, LIMITED, BOLTON. E8133 G

BIGWOOD TYPE PBC 4-ROLL MOTORISED PLATE BENDING AND STRAIGHTENING MACHINE for sale. Capacity 48in. by ¼in., rollers 55½in. long by top, 9in. diameter, others 8in. diameter, electrical equipment for 440/3/50, power rise and fall to rollers through clutches, swing-out end bearing with self-support to top roller.—Photo., &c., from F. J. Edwards, Limited, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3. E8134 G

FOR SALE

Edwards

BLISS No. 20 Inclinable Power Press, with adjustable stroke, arranged motor drive for 400/3/50, fitted with automatic press guard and guard over drive, pressure exerted approximately 20 tons, stroke adjustable from ¼in. to 2½in., size of bed 21¾in. by 13¾in. Weight approximately 22 cwt.
INCANDESCENT Forced Draft Bar Heating Furnace, double ended, gas fitted, heating chamber 36in. wide by 24in. deep by 9in. high, total length through furnace 32in. working, temperature range 900 deg. C. to 1350 deg. C., 1200 deg. C. can be reached in about 1½ hours after starting from cold.
QUICKWORK No. 321 motorised Rotary Shearing Machine, with circle cutting attachment, arranged motor drive for 400/440/3/50, capacity 14 S.W.G. mild steel, depth of shear throat 30in., cuts circles from 6in. to 60in. diameter. Weight approximately 18 cwt.
B.E.N. Model TS9 2-Stage Automatic Air Compressor Unit, comprising 2-stage vee type air-cooled compressor, arranged motor drive for 400/440/3/50, motor and compressor mounted on horizontal air receiver, displacement 9 cu. ft. per minute, working pressure 200 lb. per square inch.
BESCO High-Speed, Open-End Guillotine Shearing Machine, undercrank type, arranged motor drive for 400/440/3/50, fitted with automatic sheet hold-down and complete with front, back and side gauges, capacity, mild steel 48½in. by 14 S.W.G.
TAYLOR and CHALLEN No. 3 G.D.P. Geared, Double-Sided, Double-Action, Cam-Action Drawing Press, arranged motor drive for 400/440/3/50, punch stroke approximately 7in., blankholder stroke approximately 3½in., tee-slotted bed 18in. by 15½in., between uprights 20½in. Weight approximately 51 cwt.
Photographs of the above are available.
MACHINE TOOLS, NEW AND USED, Of Every Description. Attractive Prices.

F. J. EDWARDS, LTD.,
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LONDON, N.W.1.
Telephone : EUSton 4681–3771.
And at
LANSDOWNE HOUSE, 41, WATER STREET, BIRMINGHAM, 3.
Telephone . Central 7606–8. E207 G

NISSEN TYPE HUTS for sale. Prompt despatch of 16ft., 24ft. and 30ft. wide huts ; also " Romney " Huts, 35ft. wide, and " Blister " Hangars, 86ft. 6in. and 91ft. wide. These buildings are in various lengths and comprise steel framework with galvanised corrugated steel sheeting.—Full details from Dept. 115, J. Thorn and Sons, Ltd., Brampton Road, Bexleyheath, Kent (Tel., Bexleyheath 305). E113 G

FOR SALE

HYDRAULIC PRESSES

Unused 4000-ton HYDRAULIC HEAVY PLATE FORMING and BENDING PRESS, table 18ft. by 10ft., weight 380 tons.
2000-ton DOWN-STROKE HYDRAULIC FORGING PRESS, ram 31in. dia., admits 8ft. 7in. wide with horizontal sliding table, weight 200 tons.
1000-ton DOWN-STROKE PRESS by Loewy Eng., ram 27in. dia., bed 40in. by 48in.
650-ton DOUBLE-ACTION DRAWING PRESS by Lake Erie, bed 7ft. 6in. by 6ft. 8in., with self-contained pump unit.
MANY OTHER HYDRAULIC PRESSES OF ALL TYPES

REED BROTHERS (ENGINEERING), LTD.,
Replant Works,
Woolwich Industrial Estate,
London, S.E.18.
Telephone : Woolwich 7611/6.
E8117 G

FOR SALE, Two Holmes Connersville Electric-driven, Positive Displacement Blowers, with vee-belt drives. Capacity 2500 c.f.m. at 3 p.s.i. with 35 h.p. motor, and 5000 c.f.m. at 3 p.s.i. with 80 h.p. motor. In excellent condition, lying near Stirling.—Marples, Ridgway and Partners, Ltd., Metropolitan Station Approach Road, Watford, Herts. E7978 G

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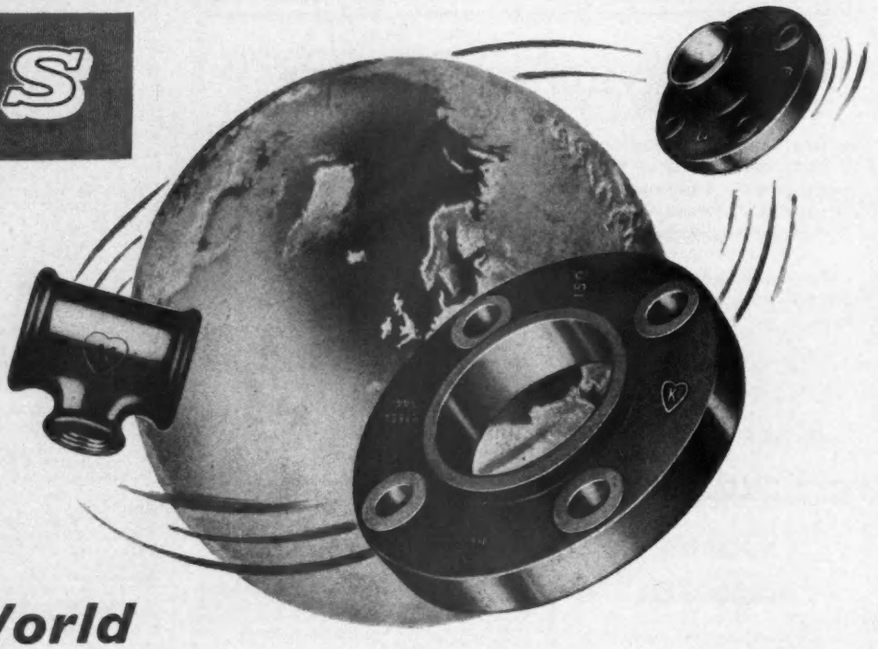
KIRKS



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FOR SALE

SOAG

WE OFFER AT ATTRACTIVE PRICES HIGH-CLASS VERTICAL MILLING MACHINES

No. 2 CINCINNATI medium speed, dial type, table size 52 11/16in. by 12¼in., capacity 28in. by 12in. by 13in.

V3 MASERATI, new, High-Speed Dial Sliding and Swivelling Head, multi-motor drive, rapid power traverse in all directions by separate motor, table working surface 59in. by 13¾in., capacity 35½in. by 11in. by 18½in., 20 spindle speeds 18–2000 r.p.m.; spindle motor 10 h.p.

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CVM25 KENDALL and GENT (Kneeless) Circular table type, table diameter 30in. capacity 30in. by 26in. by 32in.

28–60 CINCINNATI Vertical Hydro-Tel, fixed height bed, single power control lever, stepless feed regulation, rapid power traverse, table working surface 83in. by 28in., capacity 60in. by 30in., vertical 14in., 16 spindle speeds from 52–1300 r.p.m.

We also have a good stock of Plain Horizontal, Universal, Production type and Special-Purpose Milling Machines available.

ALL IN STOCK.
INSPECTION INVITED.
IT'S CHEAPER TO BUY NOW.

SOAG MACHINE TOOLS, LTD.,
JUXON STREET, LAMBETH, LONDON, S.E.11.
'Phone : RELiance 7201.
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E212 G

FOR SALE

3-ton Taylor Jumbo Hydraulic Crane, diesel-driven.
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August 26–29	Machine tools, vehicles and miscellaneous stores, including binoculars and a large quantity of cotton and linen thread	M.O.S. Storage Depot, Royal Arsenal, Woolwich, London, S.E.18	FULLER, HORSEY, SONS & CASSELL (Dept. L), 10, Lloyd's Avenue, London, E.C.3. (Tel.: Royal 4861.)
September 3–4	Machine tools and miscellaneous stores	Technical Stores Depot, Old Dalby, Melton Mowbray, Leicestershire. (Sale at Melton Mowbray.)	SHOULER & SON (Dept. L), 1, Norman Street, Melton Mowbray, Leics. (Tel.: 81.)

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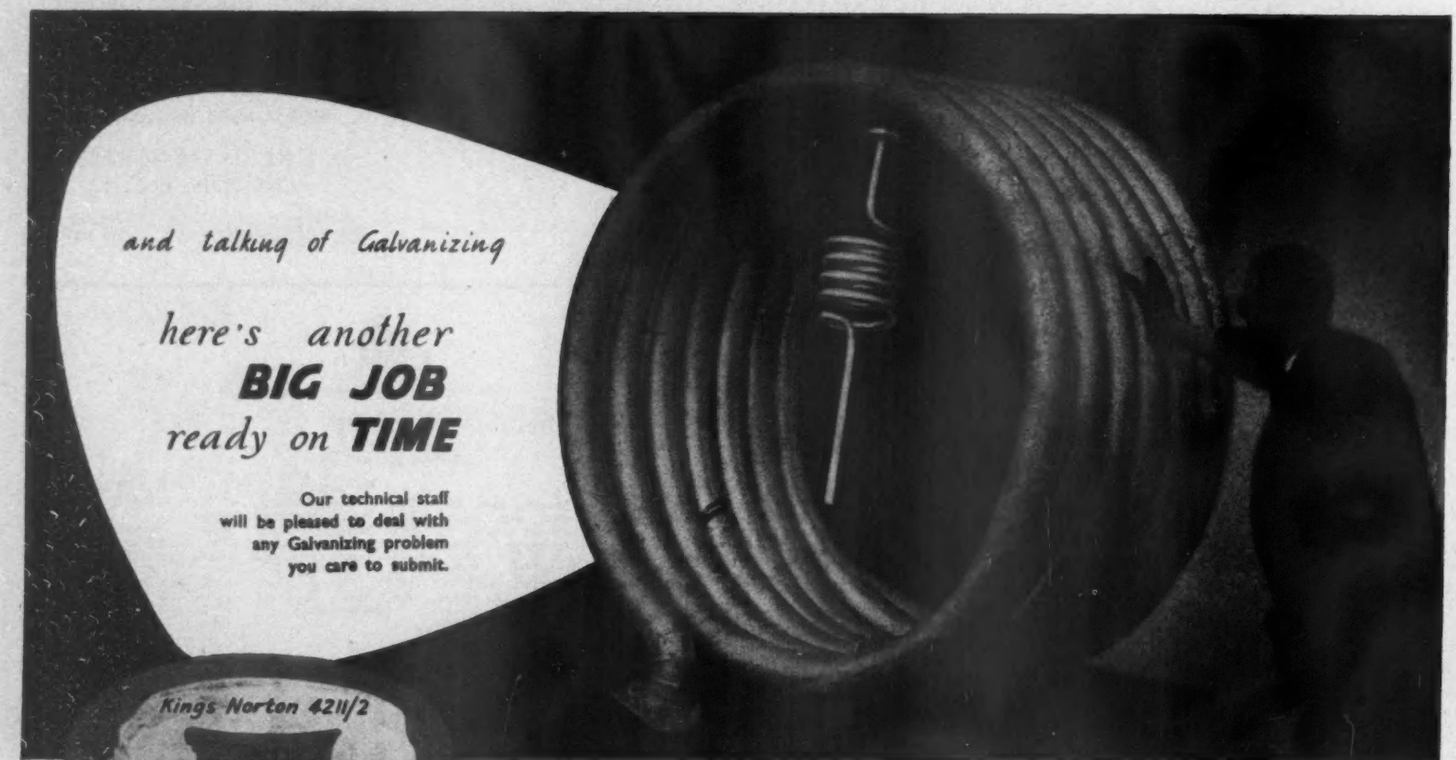
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INDEX TO ADVERTISERS

	PAGE
AB Atlas Conco/Sweden	Cover iii
Acheson Colloids, Ltd.	94
Airnesco Products, Ltd.	86
Alldays & Onions, Ltd.	22
Allen, E., & Co., Ltd.	33
Alley & MacLellan, Ltd. (Worcester)	28
Amal, Ltd.	64
Armstrong Patents Co., Ltd.	20
Armstrong Stevens & Son, Ltd.	105
Associated Lead Manufacturers, Ltd.	99
Automotive Products Co., Ltd.	64–81
Avica Equipment, Ltd.	106
B.S.A. Tools, Ltd.	114
Bache, G., & Son	79
Barlow-Whitney, Ltd.	77
Bennett & Sayer, Ltd.	15
Bird, W. H., & Sons, Ltd.	45
Birfield Industries, Ltd	82
Birmingham & Blackburn Construction Co., Ltd.	22
Booth, J., & Bros.	59
Boulton Paul Aircraft, Ltd.	93
Brett's Patent Lifter Co., Ltd.	35
British Aluminium Co., Ltd.	26
British Electrical Repairs, Ltd.	61
British Ermeto Corp., Ltd.	23
British Paints, Ltd.	94
British Rototherm Co., Ltd.	101
Broom & Wade, Ltd.	48
Brown, E. G., & Co., Ltd.	42
Brownlie & Murray, Ltd.	15
Burnley Aircraft Products, Ltd.	31
Burrell, E. C., & Sons, Ltd.	54
Butcher, H., & Co.	113
Caird, F., Ltd.	61
Carruthers, J. H., & Co., Ltd.	89
Chesterfield Tube Co., Ltd.	58
Clarke, Chapman & Co., Ltd.	21
Clyde Crane & Booth, Ltd.	59
Clyde Crane & Engineering Co.	59
Cochran & Co., Annan, Ltd.	65
Cockburns, Ltd.	2
Cooper Roller Bearings Co., Ltd.	88
Cort, R., & Son, Ltd.	46–47
Crofts (Engineers), Ltd.	70–71
Crompton Parkinson, Ltd.	56
Cross Manufacturing Co. (1938), Ltd.	64
Crowthorn Engineering Co., Ltd.	35
Danks of Netherton, Ltd.	39
Distington Engineering Co., Ltd.	10
Drum Engineering Co., Ltd.	75
Drummond-Asquith (Sales), Ltd	4–17
Eagle & Wrights (Gauges), Ltd.	15
Electronic Engineering	102
Ellison, G., Ltd.	43
Farmer, L., & Sons	113
Fearnehough, W., Ltd.	41
Ferguson Pailin, Ltd.	8
Finucane, W., Ltd.	15
Firth Brown Tools, Ltd.	97
Foord, J., & Co.	113
Freeman, Taylor Machines, Ltd.	103
Fuller, Horsey, Sons & Cassell	113
Gerhardy Bros., Ltd.	66
Glenfield & Kennedy, Ltd.	Cover ii
Goodwin, R., & Sons (Engineers), Ltd.	68
Grafton Cranes, Ltd.	95
Grazebrook, M. & W. Ltd.	115
Greenwood's Standard Gear Cutting Co., Ltd.	64
Gwynnes Pumps, Ltd.	78
H.M.S.O.	109
Hackbridge & Hewittic Electric Co., Ltd.	102
Harland & Wolff, Ltd.	98
Harlow, R., & Son, Ltd.	20
Harvey, G. A., & Co. (London), Ltd.	63
Head Wrightson Teesdale, Ltd.	13
Heap, J., & Co., Ltd.	57
Imperial Chemical Industries, Ltd.	29
Ince Forge Co.	57
International Combustion Products, Ltd.	100
International Meehanite Metal Co., Ltd.	11
Ironmonger	62
Iso-Speedic Co., Ltd.	Cover iv
Jackman, J. W., & Co., Ltd.	41
Kelvin & Hughes (Industrial), Ltd.	90
Kemp's Engineers Year-Book	79–109
Kestner Evaporator & Engineering Co., Ltd.	38
Kirk & Co. (Tubes), Ltd.	112
Knight, Frank & Rutley	113
Lafarge Aluminous Cement Co., Ltd.	53
Langley Alloys, Ltd.	16
Lansing Bagnall, Ltd.	41
Laurence, Scott & Electromotors, Ltd.	3
Ledward & Beckett, Ltd.	61
Lee, Howl & Co., Ltd.	38
Leeds Engineering & Hydraulic Co., Ltd.	40
Lees, H., & Co., Ltd.	116
Ley's Malleable Castings Co., Ltd.	52
Lilleshall Co., Ltd.	19
Lobnitz & Co., Ltd.	50
Loveridge, Ltd.	101
McAra, A.	95
Machinery Installations, Ltd.	34
MacLellan, P. & W., Ltd.	75
McNeil, C., Ltd.	53
Mallinson & Eckersley, Ltd.	115
Markland Scowcroft, Ltd.	12
Marshall, J., & Co. (Motherwell), Ltd.	92
Massey, B. & S., Ltd.	30
Mather & Platt, Ltd.	20
Matthew Hall Group of Companies	51
Matthews & Yates, Ltd.	96
Maxseal Valves, Ltd.	68
Metal Structures, Ltd.	66
Metropolitan - Cammell Carriage & Wagon Co., Ltd.	24
Metropolitan - Vickers Electrical Co., Ltd.	14–69
Midgley & Sutcliffe, Ltd.	58
Midland Galvanizers, Ltd.	114
Mills, G. (Engineers), Ltd.	39
Mirrlees (Engineers), Ltd.	95
Montgomerie, Stobo & Co., Ltd	73
Mould, A. H., & Sons, Ltd.	22
Neill, J., & Co. (Sheffield), Ltd.	15
Newall, A. P., & Co., Ltd.	16
Niagara Screens (Great Britain), Ltd.	39
Non-Ferrous Die Casting Co., Ltd.	35
Norris Brothers, Ltd.	61
Norton, Sir J. Farmer & Co., Ltd.	5
Oscard, J., & Co.	27
Parsons, C. A., & Co., Ltd.	83
Peckett & Sons, Ltd.	40
Pegler & Louden, Ltd.	91
Pinchin Johnson & Co.	45
Pitman, Sir Isaac, & Sons, Ltd.	109
Plenty & Son, Ltd.	92
Plowright Bros., Ltd.	34
Pollard, F., & Co., Ltd.	54
Positive Lock Washer Co., Ltd.	39
Price, J. T., & Co., Ltd.	50
Prior Stokers, Ltd.	105
Radiovisor Parent, Ltd.	24
Rawlplug Co., Ltd.	7
Reavell & Co., Ltd.	76
Record Electrical Co., Ltd.	27
Renold Chains, Ltd.	87
Renshaw Foundry, Ltd.	62
Research Engineers, Ltd.	57
Revolvo, Ltd.	19
Reyrolle, A., & Co., Ltd.	18
Rhodes, R., & Son, Ltd.	38
Rhodes, J., & Sons, Ltd.	54
Richards, J., & Sons, Ltd.	23
Richards & Partners	113
Richmond Welding Co.	102
Riley, A. J., & Son, Ltd.	101
Robertson & Ferguson, Ltd.	5
Robertson Thain, Ltd.	49
Robson, G., & Co. (Conveyors), Ltd.	54
Rubber By-Products (Warwickshire), Ltd.	38
Russell, G., & Co., Ltd.	115
Sadi Engineering Co., Ltd.	98
St. Georges Engineers, Ltd.	76
Sale, H. E., Ltd.	68
Saunders Valve Co., Ltd.	6
Schieldrop & Co., Ltd.	101
Sheepbridge Alloy Castings, Ltd.	79
Sketko Ball Bearing Co., Ltd.	60
Small, W. H., Ltd.	86
Smedley Bros., Ltd.	35
Smith, J. (Keighley), Ltd.	74
Smiths Industrial Instrument Division	80
South Durham Steel and Iron Co., Ltd.	72
Stamgo Manufacturing Co., Ltd.	102
Standard Piston Ring & Engineering Co., Ltd.	66
Steel Construction Co., Ltd.	65
Steelway, Ltd.	27
Stein, J. G., & Co., Ltd.	36
Stream-Line Filters, Ltd.	62
Summerson, T., & Sons, Ltd.	91
Sykes, H., Ltd.	37
Taylor & Hubbard, Ltd.	105
Taylor, Taylor & Hobson, Ltd.	45
Teale, J. W., Ltd.	102
Technoexport	32
Technological Institute of Gt. Britain	108
Terry, H., & Sons, Ltd.	91
Thomas, R., & Baldwins, Ltd.	Cover i
Thorn, J., & Sons, Ltd.	7
Tonks, J., & Co., Ltd.	102
Town, F., & Sons, Ltd.	42
Trewhella Bros. Pty., Ltd.	7
U.K. Hyster Dealers	68
Unbrako Socket Screw Co., Ltd.	86
Vacuum Industrial Applications, Ltd.	66
Visco Engineering Co., Ltd.	2
Vokes, Ltd.	67
Ward, T. W., Ltd.	25–112
Warne, Wright & Rowland, Ltd.	44
Welding Technical Services, Ltd.	104
Wellman Bibby Co., Ltd.	15
Wellman Smith Owen Engineering Corporation, Ltd.	55
Weston, C., & Co., Ltd.	9
Westool, Ltd.	104
Wheatley Kirk, Price and Co.	113
Whitehouse Industries, Ltd.	85
Wiggin, H., & Co., Ltd.	57
Wiggins, F., & Sons	115
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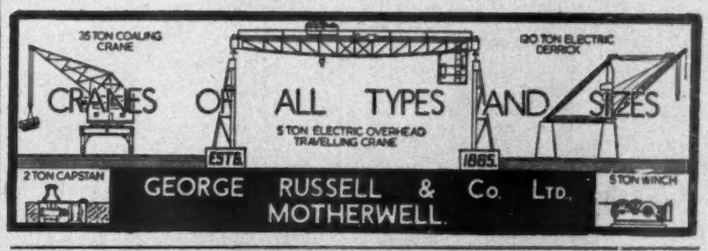

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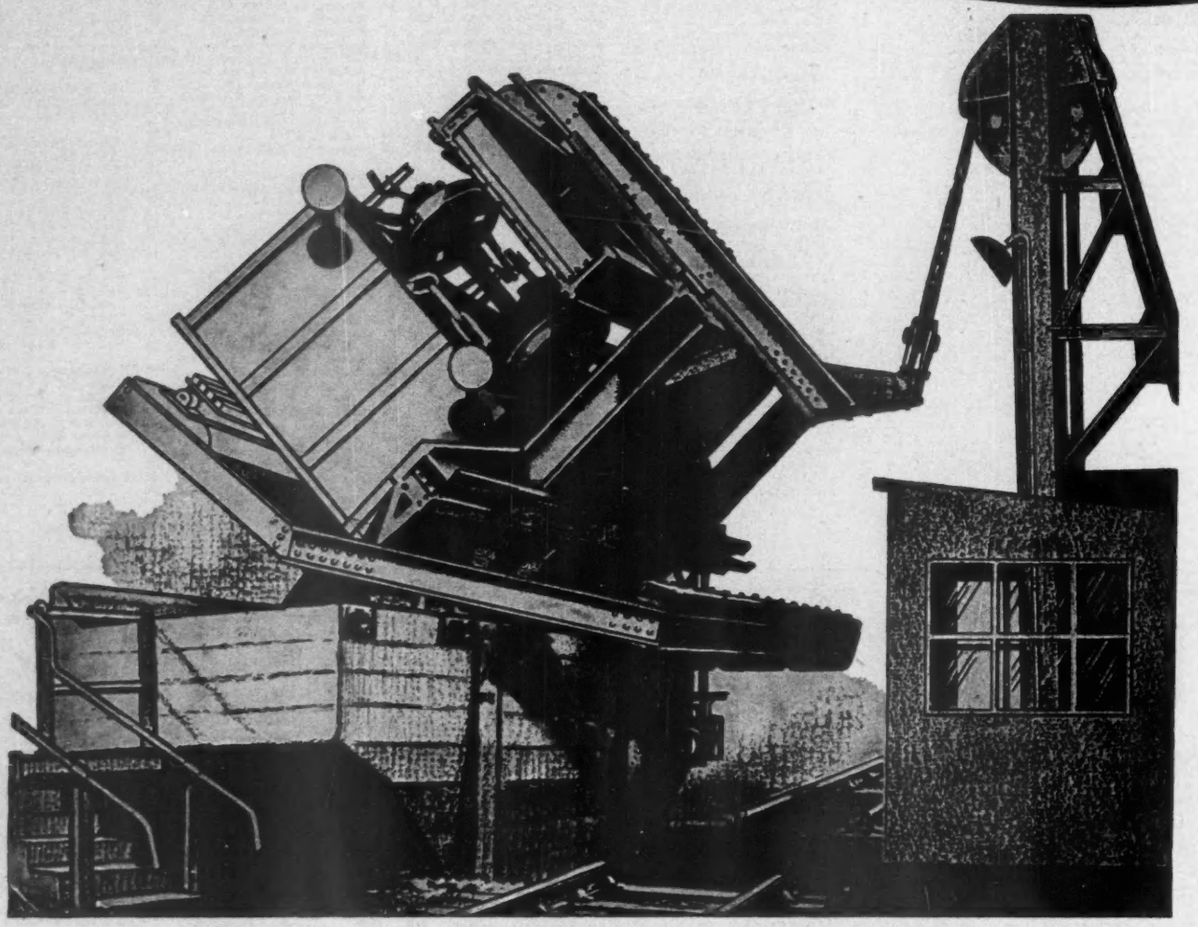

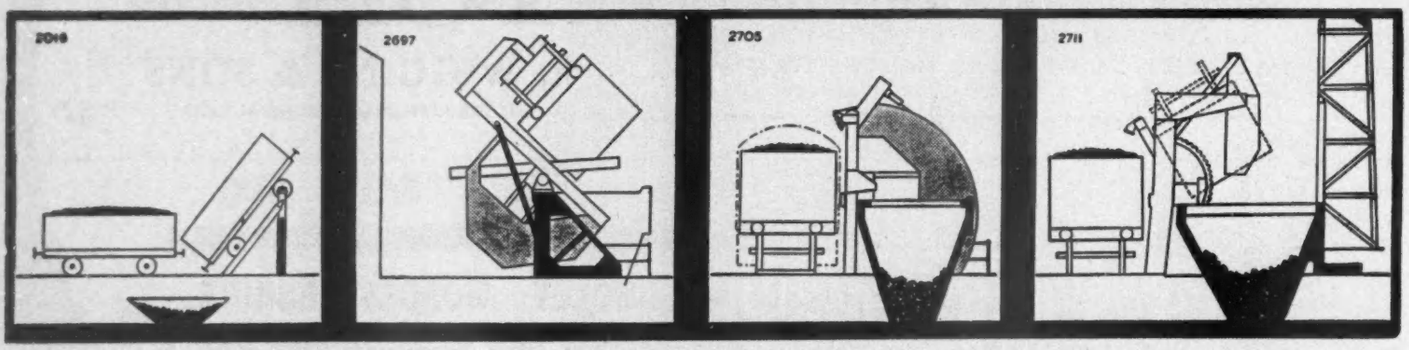

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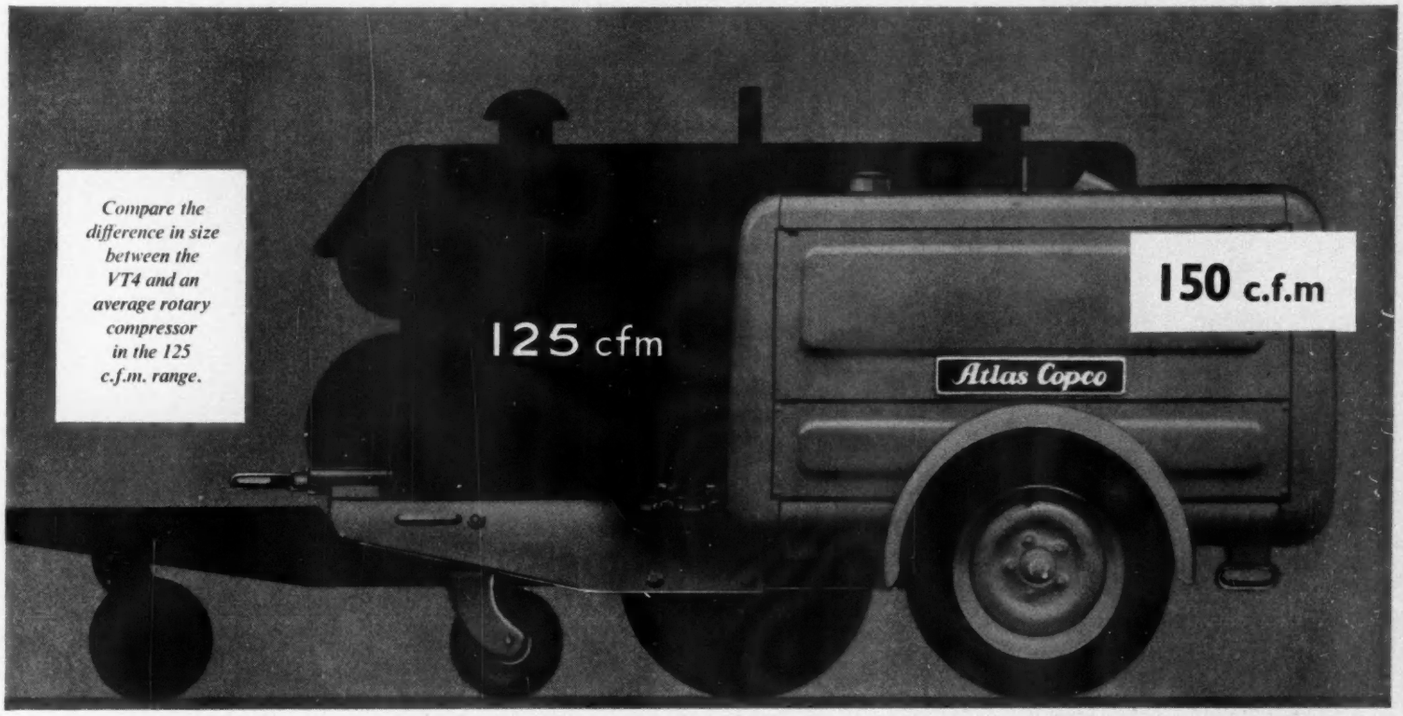
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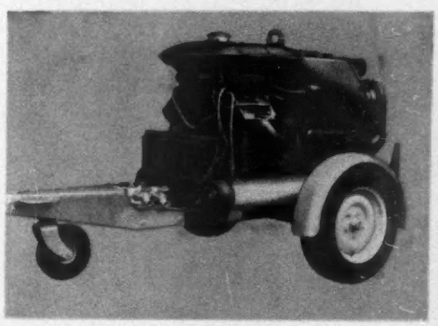

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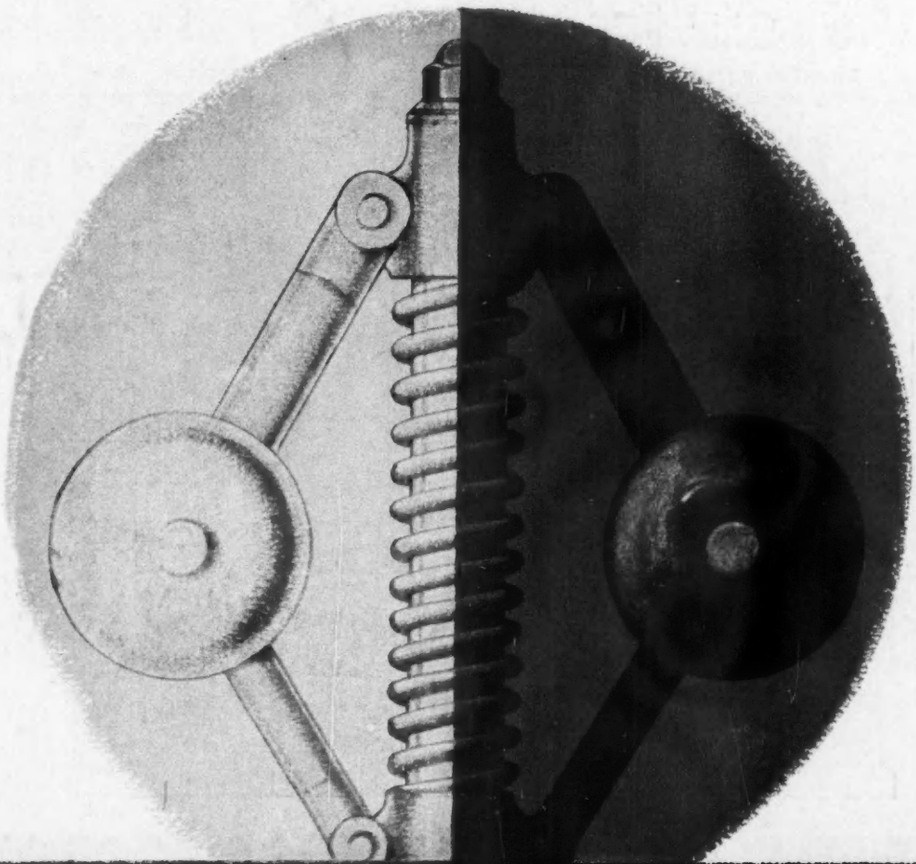

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